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MARVELOUS WORKS

OF

NATURE AND ART,

TOGETHER WITH

USEFUL AND INTERESTING INFORMATION FOR ALL,

WITH PLATES OF ILLUSTRATION.

BY

LORING COOK.

UTICA, N. Y.
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PREFACE.

It is interesting, edifying and beneficial to become acquainted with the mighty, wonderful, curious and mysterious works and operations of our Creator upon the surface of the globe on which we live. Such a knowledge has a tendency to lead the human mind to the acknowledgment of a great first cause, and to the existence of an Almighty Supreme Being, who created and governs all things.

The great variety of subjects embraced in this volume, such as the marvelous works of Nature, Art and Science, together with a great variety of other information, will not only make it interesting, useful and instructive, but a cabinet of information, and valuable as a book of reference, such as every person would do well to have in his possession.

We find on all parts of the globe the changing and devasting power of God, and that nothing remains in one stay upon this earth, nothing stable short of heaven. The wisdom and power of God is displayed in various ways of sublime grandeur, beauty and skill on various parts of the earth, and particularly in his mighty works recently discovered among and in the defiles of the Rocky Mountains, heretofore hid from the view of civilized man by the deep, untraveled wilderness of the mountains.

From recent discoveries made, we may well say that North America is favored with more grand, beautiful and majestic works and wonders of Nature than any other one portion of the globe. Here we find the most grand, beautiful and majestic waterfalls yet discovered on the globe; perpendicular walls of rock thrown up from the ground several thousand feet in height; mud and water geysers more numerous and exciting than those in Iceland; hundreds of volcanoes throwing up their heated contents; boiling springs, the waters of which are of different colors, pink, red and brown; petrifying springs, standing trees of stone; mammoth trees, the largest on the globe; sulphur springs and sulphur mountains; cities covered up by volcanic eruptions; a dreary looking glen containing hundreds of boiling sulphur springs, throwing up their sulphurous fumes and vapors in a frightful and horrid manner; coral islands, coral reefs and coral insects; gulf stream, fall and slide of mountains; geography of volcanoes; earthquakes; northern rocks carried southward; sand floods; tower and city of Babel, surrounded by a wall 350 feet high and 87 feet thick; the great wall of China, 1,500 miles in length; pyramids of Egypt, the base of one of them covering eleven acres of ground and is 450 feet high; Cleopatra's needle, &c.

CONTENTS.

PAGE.

Big Trees in California,..... 7
Yosemite Valley,..... 15
Cliff Falls and Wonders,..... 21
Geysers of California,..... 36
Geysers on the Yellowstone,.....114, 147
Mineral Springs, California,..... 35
Petrified Forest,..... 35
Borax Lake,..... 42
Orchard, the largest known,..... 42
Wonders of the Wilderness on the Yellowstone,..... 44
Tower Creek and Fall,..... 61
A Hideous Looking Glen..... 65
Great Falls and Canyon of the Yellowstone River,..... 68
Muddy Geyser and Volcanoes,..... 82
Analyses of Springs in Yosemite Valley,..... 110
Geyser called Old Faithful,..... 114
Falls of Niagara,..... 149
Canyon of the Colorado River,..... 152
Penobscot River and Marvels,..... 153
Large Trees of Pine,..... 173
Large Top Tree of South America, spreading 614 feet, ... 179
Cow Tree,..... 180
Barometer to Measure Heights,..... 181
Principles of the Barometer Applied to Pumps,..... 183
Weather Glass,..... 186
Travels in South America,..... 191
Andes and Rocky Mountains,..... 232
Pyramids in Egypt,..... 233
Sphinx of Egypt,..... 267

Brass Statue of Rhodes,..... 275
Cleopatra's Needle,..... 276
Temple in Honor of Minerva,..... 278
Wall of China,..... 283
Babel Tower and City,..... 291
Destruction of Rocks,..... 306
Fall of Mount Grenier,..... 307
Fall of Rocks from the Alps,..... 309
Power of Moving Bodies,..... 310
Exporting Power of Water,..... 314
Mountain Slides,..... 329
Flood in the Valley of Bagnes,..... 332
Baths of San Vignot,..... 335
Baths of San Philippo,..... 336
Springs of St. Michael,..... 336
Destroying Effects of the Sea,..... 337
Downs or Sand Hills,..... 343
Formation of Coral Islands by Coral Insects,..... 348
Effects of the River Po,..... 358
Delta of Rivers,..... 362
Geography of Volcanoes,..... 367
Temple of Jupiter Serapis,..... 428
Gulf Stream,..... 434
Noah's Ark,..... 437
Recent Discoveries at Pompei,..... 439
Miscellaneous,..... 441
Ramie,..... 442

THE DISCOVERY OF BIG TREES IN CALIFORNIA.

A hunter, while in pursuit of game in the mountains of California, accidentally found himself in the midst of these large trees. His description of large trees was so marvelous no one would believe him. He, therefore, to convince them of the truth of these wonders, told some of the miners in the mountains that he had killed a large grizzly bear, and wished them to go and help him bring it in. They went with him. He led them into the midst of the large trees, and then told them they were the grizzly bear. Their united descriptions found their way into the papers, and was soon heralded throughout this country and Europe.

The Americans named the forest Washington Gigantea, in honor of our noblest military hero; the Europeans named it Wellingtonia Gigantea, in honor of their greatest military chieftain. Decaisne, a French botanist, discovered that it belonged to the same genus as the Cali-

fornia redwood, now known in science as S. Gigantea.

The genus was named in honor of Sequoyah, a Cherokee half-breed, better known as George Guess, who lived in the northeast corner of Alabama, and invented for his tribe an alphabet and written language. There were in it eighty-six characters, representing a sylable each. It was considerably used, and a paper was printed partly in these characters. This was done in the first third of the nineteenth century.

These trees appear to grow in groves, situated in California between 36 and 38½ degrees north latitude. There are said to be nine groves discovered. The most noted are the Calaveras and Mariposa, the first the farthest north of all.

The Calaveras grove lies within seventy-five miles of Stockton, by rail and stage. You can ride to the hotel within this grove. This grove is about half a mile long, and one-eighth of a mile wide. The large pines in the California groves are said to be the largest of the vegetable kingdom, when height and diameter are both taken into account. Some of the enca-

lypti trees in Australia are one hundred feet higher, but the diameter is much smaller. The baobab in Africa is larger in diameter, but only of a medium height.

In the Calaveras big tree groves there are over 100 trees, 20 of which are over 25 feet in diameter at the base—some of which are 320 feet. One found lying prostrate upon the ground, the top of which had been broken off, is said to be 110 feet in circumference at the base, and 435 feet in length. This is larger than any now standing. In 1853 one of the largest was felled; it took five men 25 days to fall it, with pump augers and wedges; it was 300 feet in length, and 96 feet in circumference on the ground. It was 80 feet in circumference six feet from the ground, and large enough to accommodate four sets of quadrilles on the stump, on which a dancing party amused themselves. And on its prostrate trunk a house and a double bowling-alley, 80 feet long, have been built. A section of this tree was cut 40 feet from the stump, and taken to the eastern cities for exhibition.

The trunk of another tree found lying upon the ground, called the burnt tree, is hollow, and

will admit a person on horseback to ride sixty feet through its hollow trunk, going in through one knothole and coming out through another.

The tallest tree now standing is called the Keystone State, 325 feet high, but only 45 feet in circumference six feet from the ground.

A large number of trees in these groves, which range from 230 to 300 feet in height, are from 25 to 30 feet in circumference, and a still larger number of smaller ones are fast stretching up as if to outstretch the largest giants.

These largest trees in giant form have received names as follows: Hercules, General Jackson, Washington, Daniel Webster, Henry Clay, Old Bachelor, Old Maid, Siamese Twins, Mother and Son, Uncle Tom's Cabin, &c.

At the entrance of this grove, the trees called the Sentinels stand on either side of the passage into the grove. They are about fifty feet in circumference, and 275 feet high, and appear as if they were on guard to the entrance of the Giant Grove. Between them you pass into this grand temple-like forest.

The Mariposa Grove is also in a depression, accessible at present only on horseback or on

foot. This grove is about two miles square, and its trees are more numerous, less lofty, but larger than those of the Calaveras Grove.

Many of the trees are burned at the base, probably by the Indians, and many have large cavities thus made in their standing trunks, through which you can ride on horseback, and in which a large party could be sheltered from a storm.

Many younger trees are growing all around, from 100 to 200 feet high; and probably there is no danger of the species becoming extinct, as the groves are guarded and protected by Mr. Galen Clark, the State Guardian. The cones of these trees are not more than two inches long, while the cones of the sugar pine (a smaller tree) are one and a half to two feet long; the seeds of which are small and light and germinate readily in the East; where they have been planted they grow about two feet a year, and are considered a beautiful and interesting parlor ornament.

The foliage is sometimes like the arbor-vitae; the bark smooth, porous, light, and cinnamon-colored; the wood red, as in redwood, light, spongy, and of not much use in carpentry.

Although these mammoth trees are not as high by 100 feet as some of the Australian trees, and less in diameter than the African Adansonia, yet taken altogether they must be regarded as the grandest type of the vegetable world. The Pitch or Yellow Pine also grows in California to a very large size, yet many admire the Sugar Pine.

The Sugar Pine, (*P. Lambortiana*), which grows to the height of 300 feet, with a diameter of 10 or 12 feet, receives its name from a white manna-like exudation from the bark, whose sweet taste may tempt one to partake of it freely, to the great and painful disturbance of the abdominal contents, as it is a powerful purgative; the cones are of a great size, and hang like sugar-loaves from the branches.

The traveler by the Mariposa route generally visits a large pine of this species, called the Hermit's Cave, where an eccentric person passed a large part of the year. There was in its base, hollowed out by fire, room enough for a bed of leaves, fire-place, and closet; the smoke of his fire ascended through a long chimney in the center, the result of the natural decay of the tree.

The dead branches of the pines are covered with bright yellow moss and lichens, and the oaks in the valleys near the sea-level are festooned with long folds of grayish moss, which swinging in the wind, give a mournful aspect, much like that produced by a similar growth in the Cypress Swamps of the South.

The Nut Pine (*P. Edulis*). The seeds of this tree are largely eaten by the Indians, and its wood is in great request for all kinds of structures under water. The wood is extremely crooked, and apt to warp in the air to such an extent that it is jocularly said, that a stick will crawl over a ten-acre lot in twenty-four hours.

RED WOOD TREES.

The red wood trees are so called from the color of their wood, and is limited to the ocean. These trees are only found along the coast from 36 to 42 degrees north latitude. Near San Francisco and the large towns they are all cut down, but in other places constitute large forests 100 miles long and 10 to 15 wide. They are almost as grand and lofty as the Big Tree pines, being from 50 to 70 feet

in circumference, and 275 feet high, and form entire forests.

The Big Pine trees occur in groups or groves among other trees, presenting, therefore, a grander sight, with their straight trunks, without branches for 100 to 150 feet. The contrast of the cinnamon-colored trunks and the deep green foliage, shutting out the sunlight above, with the gloom and absolute silence of these majestic groves, prepares one to feel a gloom of mind thought, as though he might expect processions of ancient Druids or some other antagonist emerging from those stately avenues.

YOSEMITE VALLEY.

HOW IT WAS FIRST DISCOVERED BY THE WHITES.

The white people or miners living on the streams in the mountains, in 1850, were greatly harrassed by the Indians. The whites, seeing they must defend themselves, formed themselves into a military company, started in pursuit, and followed them up, over mountains, through dark and deep glens, and finally drove them into the Yosemite Valley, which the Indians supposed to be a safe retreat from their pursuers. This expedition was the first discovery of the Yosemite Valley by the whites.

Yosemite is an Indian word, meaning a large grizzly bear. In the spring of 1851, an expedition, under the command of Captain Boling, started to explore this valley, and to drive the Indians out of it. Guided by an old chief, Tenaya, they reached the Valley, and drove the Indians from their supposed

impregnable retreat, killing a few and making peace with the rest.

The Indians again becoming troublesome to the miners, another expedition was fitted out for the valley in 1852, by the Mariposa battalion. Some of the Indians were killed, and the rest fled to the Mono tribe, on the eastern side of the Sierra mountains. Having stolen some horses from their friends, the Monos pursued them back to the valley, where a bloody battle was fought, resulting in the almost entire extermination of the Yosemite tribe. The descriptions which the soldiers gave of the valley were so wonderful the people gave but little credit to them.

Mr. J. M. Hutchings, who has made himself familiar with the valley and its marvelous wonders, has now located himself in the valley, and who keeps a hotel, appears to have been the first to induce a party of wonder-seekers to visit the valley of wonders in 1855. In the same year another and larger party from Mariposa visited the valley. In 1856 the travel of tourists commenced, and now large numbers, both male and female, visit the valley annually. In 1856 the first house was

built in the valley, opposite the Yosemite Fall. It is now kept as a hotel. There are now three hotels there. In 1860, Mr. J. C. Lamon took up his residence in the valley, where he now lives, and succeeded in raising excellent garden vegetables and very fine berries and other fruit for the market. He thinks he has a claim to the land cultivated by him self, and considers that he is a *bona-fide* settler. Many summer residents have since put in their claims to certain tracts of land in the valley. All these claims are invalid under the laws of the United States, for the reason the land was not open to pre-emption, never having been surveyed and put into the market. Some scientific gentlemen, familiar with the Yosemite Valley, seeing that certain individuals were putting in for claims of land in the valley for individual speculation, petitioned to Congress to make it a Public Park for all time to come, and it was ceded to the State of California by an Act of Congress, as follows:

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled,

That there shall be, and is hereby, granted to the State of California, the cleft or gorge in the granite peak of the Sierra

Nevada Mountain, situated in the County of Mariposa, in the State aforesaid, and the head waters of the Merced River, and known as the Yosemite Valley, with its branches and spurs, in estimated length fifteen miles, and in average width one mile back from the main edge of the precipice, on each side of the Valley, with the stipulation, nevertheless, that the said State shall accept this grant upon the express condition ; shall be inalienable for all time ; but leases, not exceeding ten years, may be granted for portions of said premises. All incomes derived from leases of privileges, to be expended in the preservation and improvement of the property, or the roads leading thereto ; the boundaries to be established at the cost of said State, by the United States Surveyor-General of California, whose official plat, when affirmed by the Commissioner of the General Land Office, shall constitute the evidence of the locus, extent, and limits of the said cleft or gorge ; the premises to be managed by the Governor of the State, with eight other Commissioners, to be appointed by the Executive of California, and who shall receive no compensation for their services.

SECTION 2. And be it further enacted, That there shall likewise be, and there is hereby granted to the said State of California, the tracts embracing what is known as Mariposa Big Tree Grove, not to exceed the area of four sections, and to be taken in legal subdivisions of one-quarter section each, with like stipulations, as expressed in the first section of this Act as to the State's acceptance, with like conditions as in the first section of this Act as to inalienability, yet with the same lease privileges ; the income to be expended in the preservation, improvement, and protection of the property, the premises to be managed by legal subdivisions as aforesaid ; and the official plat of the United States Surveyor-General, when affirmed by the Commissioner of the General Land Office, to be the evidence of the locus of the said Mariposa Big Tree Grove.

This Act was approved by the President, June 30, 1864.

After the approval by the President, Gov. Low, of California, issued a proclamation, taking possession of the tracts thus granted, in behalf of the State, appointing Commissioners to manage them, and warning all persons against trespassing or settling there, without authority, and forbidding the cutting of timber and other injurious acts. The necessary surveys were made, and the limits of the valley and the Mariposa Grove were established in the same year.

The grant by Congress had no validity until the State, by its Legislature, had solemnly promised to accept the trust, forever binding when once accepted.

At the next session of the California Legislature, an Act was passed accepting the valley and the grove, on the conditions imposed by Congress, and containing provisions for the punishment of persons committing depredations on the premises, and appointing a Guardian of the grant.

Since the passage of this Act the vandalism of the grove, who would have cut down a giant tree to build their houses, has been in a great measure arrested. Visitors, however,

may remember a huge pine prostrate, near the upper hotel in the valley, cut down in the winter of 1869–70, by persons whom Mr. Galen Clark, the guardian, had succeeded in placing in the hands of justice.

This famous valley of wonders is situated in the middle of the Sierra Mountains, which is here about 70 miles wide, and is nearly in the centre of the State of California, north and south, and nearly east from San Francisco, and is distant 155 miles therefrom, and 250 miles by the usual line of travel. In going to this valley from San Francisco or the ocean you ascend 11,400 feet to the brink of the valley at the Sentinel Dome or Glacier Point, which stand on the south brink 3,500 feet above the bottom of Yosemite Valley. Merced River is formed in the eastern end of the valley by the union of three principal branches, and runs a westerly course through the length of this valley, and is about 70 feet wide. Where the river leaves the valley the canyon or gorge in the rock is so narrow, rough and craggy, it is next to impossible for any one but an Indian or an Alpine climber to enter the valley by this canyon of the river.

Therefore the valley has to be entered from the side, either by the Mariposa route on the south side, or Coulterville route on the north. Travelers coming from the East to visit this valley should stop at Stockton, California, and then take the stage for the valley.

THE CLIFFS, FALLS AND WONDERS.

Arriving at the Sentinel Dome or Glacier Point by the Mariposa route, the view is grand, sublime, and beyond description. The Sentinel Dome is a great rounded, smooth mass of granite. There are upon it a few stunted pines, and one remarkable one on the summit, a welcome support to cling to during the high winds which prevail there. You may ride to the very top, but most persons prefer to walk, especially in descending, so slippery is the bare rock. Looking north-east up the Tenaya Canyon, in which is one of the forks of the Merced River, and the beautiful Mirror Lake, you have on the left, in the distance, the snow-covered Mount Hoffman, and almost under it the North Dome, 3,568 feet above the valley, the upper portion of the rounded, concentric-layered, granite mass,

a portion of the Royal Arches, is inaccessible from the valley, but easily ascended by a ridge which runs to the north. This magnificent dome is worthily supported by the Royal Arches, by the side of which man's proudest architectural monuments are utterly insignificant. On the right, or south border of the canyon, is the Half Dome, standing out from the main ledge of rock like a half circle, with its stupendous vertical face, of 3,000 feet from the summit, then a steep slope, of about 70 degrees, of 2,700 feet more, the top being absolutely inaccessible. Beyond is the Cloud's Rest, 700 feet higher, making it 3,400 feet high, but belonging rather to the Higher Sierra than to the Yosemite Group. On the opposite side is Mount Watkins, named from the eminent photographer of this region, and beyond this the distant Sierra.

The Sentinel Dome is 4,150 feet above the valley, and the Half Dome is nearly 600 feet higher. To the east is seen the Nevada Fall, with Mount Broderick, or the Cap of Liberty, to the left of it; in the far distance the Lyell Group, and to the south-east the steep, inaccessible granite peak named the Star King, belonging to the Merced Group.

belonging to the Merced group. About half a mile north-east of the Sentinel Dome, and directly in a line with the edge of the Half Dome, is Glacier Point, overhanging the valley, and presenting a view which for beauty and grandeur is by many regarded as the finest around the valley. Both the Vernal and the Nevada Falls are in sight to the east, separated from each other about a mile, and the nearest one, the Vernal, is a little more than a mile from the spectator. The point is fringed almost to the edge with Jeffrey's pine. The view of the Half Dome, only two miles distant, and directly in line, is grand in the extreme. To the north is seen Yosemite Fall, 2,600 feet high, and to the west, limiting the vision, is the massive El Capitan, a solid block of granite, 3,000 feet high, projecting squarely into the valley, with almost vertical sides. Below you see the green of the valley contrasting beautifully with the cold gray of the bare rocks—the tall pines looking like shrubs, and a man scarcely discernible. The thread of the Merced River sometimes glistens in the sun, and the garden of Mr. Lamon forms a pleasing feature, with

its greenness and orderly arrangement. Travelers who fail to visit this point lose one of the finest views in the whole Yosemite.

Coming in from the Mariposa route to Inspiration Point, you descend 3,000 feet down the slope of the mountain to the valley. You come at every turn upon views of surpassing grandeur and beauty. On the left stands the massive El Capitan, an immense block of bare, smooth, light-colored granite, 3,300 feet high, projecting squarely into the valley, and with almost vertical sides. At first you cannot realize its stupendous bulk and height; nothing but climbing about among them will open your eyes to the amazing heights of the cliffs and falls. Of El Capitan, Whitney says it seems as if hewed from the mountains on purpose to stand as the type of eternal massiveness. It is doubtful, if anywhere in the world is presented so squarely cut, so lofty, and so imposing a face of rock. In a recess in one corner is the Virgin Tear Fall, 1,000 feet high, rarely seen by travelers, as the creek which supplies it is dried up early in the season. It is superior, while it lasts, to the famous Stubbach Fall in Switzerland, the admi-

ration of Alpine tourists, and one of the finest in Europe.

The Indian name of El Capitan is Tutocanula, said to be an imitation of the cry of the cranes, which in winter used to enter the valley over this rock. Directly opposite is the beautiful Bridal Veil Fall, about 700 feet in perpendicular height, and 200 feet more of cascades, as it rushes over the debris at the foot of Cathedral Rock, over which it pours. The creek which supplies this fall you pass when going to Sentinel Dome, and the coolness of its clear water is sure to be tasted by the traveler and his horse. In the dialect of the Indians, this is Po-hono—a blast of wind, or the night wind, from the chilliness of the air experienced by coming under the cliff, and perhaps from the swaying of the sheet in the wind like an evil spirit, whose breath was a dangerous and deadly wind. Whatever its derivation, the poetical name of the Indian is here, as in other places in the valley, much superior to the English one. As in all the falls, the amount of water varies with the season, being greatest in May and June. It is most beautiful later in the summer, when the

volume of water is small, as it then sways more gracefully in the wind.

The Cathedral Rocks, over which the Bridal Veil falls, are neither so high nor so vertical as El Capitan. Though only about 2,600 feet high, they are very grand, whichever way you look at them. From one point, the pinacles called the Spires are so squarely cut that they remind you of the towers of Notre Dame in Paris. These grand masses, amid so many grander, are hardly noticed by the tourist. What appears on the top like bushes are evergreens, 125 to 150 feet high—as large as those which excite your wonder in the valley. On the opposite side is a triple group of rocks, known as the Three Brothers, rising one behind the other, the highest being 4,200 feet above the valley. The Indian name is Pompompasus, or Leaping Frogs, from a fancied resemblance to three frogs with their heads turned in one direction, the highest in the rear, as if in the act of leaping.

Nearly opposite the Brothers, just in the rear of the first hotel, or Ludwig's, is Loyal or Sentinel Rock. This is a slender peak of granite, over 3,000 feet high, the upper third

standing up like an obelisk or signal tower. It is one of the grandest masses of rock in the valley. Behind it, and more than 1,000 feet higher, is the Sentinel Dome, before described, not seen from the valley. From Sentinel Rock descends a small fall, 3,000 feet high, 400 feet higher than the Yosemite Fall, but reduced in July to a mere thread, unperceived by most travelers. In early spring it is a very beautiful cascade.

The great feature in the valley to most persons is the Yosemite Fall, just opposite, surpassing in height all others, here or elsewhere, having an equal body of water. The grandeur and beauty of this fall and its surroundings are magnificent. The creek which supplies the water is fed by the melting snows of Mount Hoffman Group, ten miles to the north-east. Of course the volume of water varies greatly, being very large in spring, but in August it is reduced two-thirds. According to Professor Whitney it is twenty feet wide and two feet deep. The height is 2,600 feet—half a mile. A vertical fall of 1,600 feet, swaying in the wind, and broken into spray in a most beautiful manner, and falling

into a deep rocky recess; then a descent, in a series of cascades, of 600 feet to the bottom of the valley, falling upon a rough assemblage of rocks; then flowing off to join the Merced River, being ignominiously made to turn a saw-mill on its way. All the falls you see well from the Sentinel Dome, opposite, a distance of two and a half miles, and considerably above them. It is impossible to imagine anything finer than this scene, under the full moon.

A mile or two above the Yosemite Fall, the valley branches into three canyons, the middle one kept by the main Merced River, with the Vernal and Nevada Falls, the little Yosemite Valley (a miniature copy of the greater), and the ascent to the Lyell Group, where the river heads. On the left hand is the Tenaya canyon, and on the right the Illilonette. Just before these branches is the Washington Column (Shokoni), 2,500 feet high, and the Royal Arches (Tocoya, or the Basket), supporting, as it were, the North Dome. The last is about 3,700 feet high, made up of huge concentric plates of granite, overleaping each other. The Half, or South Dome (Tisayae),

opposite, about 6,000 feet high, is another magnificent mass of smooth, rounded granite, looking as if the western half had been split off and swallowed in abyss. It is truly a wonder among wonders.

Following up the Tenaya canyon, over a very rough trail, among boulders and rolling and rough stones, you come to Mirror Lake (Waiya), so called from the reflection in its still clear water of the surrounding peaks, Mount Watkins and others. Farther up is Cloud's Rest, nearly 7,000 feet high, connecting with the higher Sierra, and frequently surrounded by clouds when the other peaks are clear. Returning and going up the canyon of the main Merced River, you visit the vernal and the Nevada Falls, each the body of the main river. The trail is in many places difficult, but no where dangerous, with ordinary care. You are almost constantly ascending, winding in and out, up and down, along the banks of the stream which flows with great rapidity and turbulence in its rocky bed, affording some enchanting views of mountain and cascade scenery. After about a mile's climbing, you arrive in sight

of the Vernal Fall (Piwyack, white water, or shower of diamonds), about 400 feet high. The granite behind the sheet is square, and little, if any, eroded by the falling water, so that it is hard to believe that this canyon and fall have been the result of any causes now in action there; there must have been a subsidence, as most observers think was the case, in the formation of the valley itself. The trail up the canyon in its upper portion, around and along the steep side of the mountain, is slippery and wet with the spray. You can ride by a rough road to the top, but most persons prefer to walk. You can go no farther than the base of the cliff by the path, and you willingly stop to rest and admire the ever-changing rainbows over the water, and enjoy the refreshing coolness and shade. At this point there is a spacious cavern, formed in the concentric layers of granite, peculiar to this region. This was once probably the lair of wild animals and the still wilder Indian, as it is now said to be of the rattle snake. The ascent is now made by perpendicular and not very strong ladders of wood, making the nervous tremble lest their feet should slip,

and anxious lest they should meet a rattle snake sunning himself on the landings along the ascent. At the summit the view down the canyon is indescribably grand, and the more enjoyable as a parapet of granite runs along the edge, just high enough to support you in safety almost on the very brink.

Going up the stream by a very rugged and often steep path, winding around immense boulders which have fallen from the heights on each side, the beautiful Merced River, foaming along in its rocky bed, with rapids succeeding each other in endless variety, in one place shooting like silver lace-work over a smooth surface into a pool of emerald hue, crossing the main and rushing stream on a rude bridge, and some of its torrents on trunks of trees, not altogether safe because steep and slippery, you come after a mile of hard climbing to the Nevada Fall (Yowiye, slanting or twisted water). This Indian name is given, because just below the edge is a projecting shelf, which receives and throws to one side a great portion of the water. This adds much to the picturesqueness of the fall by its unusual shape. It is the grandest in the val-

ley, having a large body of water of extreme purity, falling about 700 feet; it is surrounded by majestic mountains, the most noted of which is the Cap of Liberty, or Mount Broderick, 4,600 feet high, and almost as grand as the Half Dome. The descent between the Nevada and the Vernal Falls is about 300 feet. Returning, you may look up the canyon of the Illilonette, where in early spring is a fine fall of 600 feet, rarely visited from the difficulty of trail.

The Yosemite Valley is nearly level, sloping very gently to the south-west; the sluggish Merced River, about seventy feet wide, flowing through it ends in a narrower canyon to the west. It is 4,000 feet above the sea, and contains some swampy meadows, supporting alders; there are also the spruce and pine, and in the sandy parts the pitch pine, white cedar, firs and oaks. The walls are light gray, very bright in the sun, here and there discolored by organic matters in solution in the water. Most painters give the rocks a golden haze which they do not possess. The characteristics of this valley as far as is known no where else on the globe combine so large a scale.

These are: grand perspection, stupendous perpendicular cliffs, vast domes, glistening ribbons of cascades coming apparently from the clouds, thundering falls like the Vernal and Nevada, frightful chasms, crystal lakes, gigantic pines, and a beautiful river. There is a great lack of color arising from the union of cold gray granite and sombre evergreens. The valley is so narrow, and the walls so high, that the sun practically sets early in the afternoon, adding a premature dusk to the wild scenery. In early spring, when the snows begin to melt on the mountains, innumerable waterfalls appear, most of which are dried up before travelers arrive. Beautiful as they are in summer, these falls in winter, with their frozen spray forming domes more than 100 feet high, the drops rebounding in the sun like diamonds, must present a sight of surprising beauty and grandeur. How was this grand and wonderful valley formed? The theory of the California geologists is as follows: that during, or perhaps after the upheaval of the Sierra Mountain, there was a subsidence, that the bottom of the valley sunk down to an unknown depth, the support underneath having been withdrawn during the convulsion.

The following, from the *Overland Monthly*, describes the sensation which arises on viewing the Yosemite Valley:

"Such magnificence of rocks, such stupendousness of cliffs, far outstripped conception, and staggered even perception itself. You disbelieve your own eyes. Judgment fails you. You have to reconstruct it. Comparison serves you little, for you have no adequate standard with which to compare, or by which to estimate the rock mountains before you. They are like nothing else but themselves. Look at that tree, elsewhere you would call it lofty. It must be 150 feet high, and yet that wall of rock behind rises straight up to twenty times its height above it. Slowly you begin to even yourself to the stupendous scale of the gigantic shapes around you, though yet trembling and staggering under the overwhelming immensity pouring in upon you from around and above. A score of cataracts in solid rock, Niagaras in stone, pile upon each other and pour over each other in absolutely painful tremendousness. Solidified vastness, infinitely petrified, the very buttresses of eternity overpower the sight and benumb the brain. The works of

God crush out the works of man. We can only silently uncover and stand speechless, with abated breath."

MINERAL SPRINGS, CALISTOGA, CALIFORNIA.

At present the most celebrated mineral springs in California, are situated at Calistoga. (At this place it is said there is not a doctor, lawyer, or a policeman permanently located.) These waters contain iron, magnesia and sulphur; the temperature varying from icy cold to boiling point. These springs are visited by many scores of summer visitors, for health and pleasure. This location is a charming and lovely place.

PETRIFIED FOREST.

This forest is about five miles from Calistoga Springs. Within a radius of a mile are more than thirty of these fossil trees; one lying on the ground is twenty feet long, and six feet in circumference, and is broken squarely across, and into several pieces, evidently silicified before it fell. The small elevation upon which they are found is mostly solid rock. The petrified wood is so hard it will scratch glass. In this petrified wood is often found beautiful

opaline spots. In other places in California, and in Nevada, it is said petrified trees have been found.

CALIFORNIA GEYSERS.

The Geysers are in Sonoma County, twenty-two miles from Calistoga, and about nine hours' ride from San Francisco, their medicinal properties are considered equal to those of Saratoga. They merit a visit more particular for their curious phenomena among the wildest and most picturesque scenery on the mountain. Along their course runs the Pluton or Sulphur Creek. The waters found in the Geyser Canyon are alkaline, sulphurous, or acid, forming efficacious remedies for various cutaneous, rheumatic and chronic diseases; some are very cold, others boiling hot.

Lieut. Davidson describes these waters as follows: "About seventy-five feet below the hotel is the first spring of iron, sulphur and soda, with a temperature of seventy-three degrees, Fahrenheit. Going up the Geyser Gulch you come to the tepid alum and iron spring, with a temperature of ninety-seven degrees, forming in the course of twelve hours a heavy irri-

descent incrustation of iron. Within twenty feet of this is a spring, of a temperature of eighty-eight degrees, containing ammonia, epsom salts, magnesia, sulphur and iron, yielding crystals of epsom salt two inches long; higher up is a boiling spring of alum and sulphur, with a heat of 156 degrees, and near it is a hot black sulphur spring.

The following paragraphs are taken from Lieut. Davidson's account of these Geysers: "As we wander over rock, heated ground, and thick deposits of sulphur, salts, ammonia, tartaric acid, magnesia, etc., we try our thermometer in the Geyser stream, a combination of every kind of medicated water, and find it rises up to 102 degrees.

The Witches' Cauldron is over seven feet in diameter, of unknown depth. The contents are thrown up about two or three feet high, in a state of great ebullition, semi-liquid, blacker than ink, and contrasting with the volumes of vapor arising from it; temperature 105 degrees. Opposite is a boiling alum spring, very strongly impregnated; temperature, 176 degrees. Within twelve feet is an intermittent scalding spring, from which issue streams and

jets of boiling water. We have seen them ejected over fifteen feet. But the glory of all is the Steamboat Geyser, resounding like a high-pressure seven-boiler boat blowing off steam, so heated as to be invisible until it is six feet from the mouth. Just above this the gulch divides; up the left or western one are many hot springs, but the scalding steam iron bath is the most important; temperature, 183 degrees. One hundred and fifty feet above all apparent action, we found a smooth, tenacious, plastic, beautiful clay; temperature 167 degrees. From this point you stand and overlook the ceaseless action, the roar, steam, groans and bubbling of a hundred boiling medicated springs, while the steam ascends 100 feet above them all.

Following the usually traveled path, we pass over the Mountain of Fire, with its hundred orifices, thence through the Alkali, then we pass cauldrons of black, sulphurous, boiling water, some moving and spluttering with violent ebullition. One white sulphur spring we found quite clear and up to the boiling point.

On every foot of ground we had trodden,

the crystalline products of this unceasing chemical action abounded. Alum, magnesia, tartaric acid, epsom salts, ammonia, nitre, iron and sulphur abounded. At thousands of orifices you find hot scalding steam escaping, and forming beautiful deposits of arrowy sulphur crystals.

Our next visit carried us up the Pluton, on the north bank, past the ovens, hot with escaping steam, to the Eye Water Boiling Spring, celebrated for its remedial effects upon inflamed and weak eyes. Quite close to it is a very concentrated alum spring; temperature, 73 degrees. Higher up is a sweetish iron and soda spring, fifteen feet by eight; and twelve feet above is the cold soda and iron spring, incrusted with iron, with a deposit of soda; strong, tonic, and inviting; temperature, 56 degrees. It is twelve feet by five, and affords a large supply. The Pluton, in the shade, was sixty-one degrees, with many fine pools for bathing, and above for trout fishing.

The Indian Spring is about a mile down the canyon. The boiling water comes out clear as ice. This is the old medicated spring where many a poor Indian has been carried

over the mountains to have the disease driven out of him by these powerful waters. On its outer wall runs a cold stream of pure water; temperature, 66 degrees; and another water impregnated with iron and alum; temperature, 68 degrees. It is beautifully and romantically situated.

We have not mentioned the tenth part of those you pass at every step in your explorations, nor one day, nor one week will reveal them all to the inquirer. Do not suppose that desolation, fire and brimstone reign supreme; one of the wonders of the place is that grass, shrubs, and huge trees should grow on its very edge, and even overhang in many places the seething cauldron below. The most varied wood abounds around you, oaks, pine, sycamore, willow, alder, laurel and madrons."

Bayard Taylor in describing his visit to the Geysers, says: "The scenery is finer than that of the lower Alps, and the place is a mine of future wealth, and of thorough rejuvenation." Of the Witches' Cauldron, he writes: "A horrible mouth yawns in the black rock, belching forth tremendous volumes of sul-

phurous vapor. Approaching as near as we dare, and looking in, we see the black waters boiling in mad, pitiless fury, foaming around the sides of their prison. Its temperature, as approximately ascertained by Lieut. Davidson, is about five hundred degrees. An egg, dipped in and taken out, is boiled; and were a man to fall in, he would be reduced to broth in two minutes. From a hundred vent-holes, about fifty feet above our heads, the steam rushes in terrible jets. I have never beheld any scene so entirely infernal in its appearance. These tremendous steam-escapes are the most striking features of the place. The wild, lonely grandeur of the valley, the contrast of its Eden slopes of turf and forest, with those ravines of Tartarus, charmed me completely, and I would willingly have passed weeks in exploring its recesses. A pure alum spring, reminding me of the rock alum spring in Virginia, is a great resort for dyspeptics. In fact, the properties of all the famous watering places seem to be here combined, and invite the sick to come here and be healed.

Among the features of this region are the hills of crude sulphur for chemical manufac-

tures, as gunpowder, sulphuric acid, etc., of which it is said half a million tons are annually consumed. The climate is unsurpassed for its salubrity.

BORAX LAKE IN CALIFORNIA.

Borax is found in many mineral springs in California. Borax Lake, which is situated in a volcanic region, about thirty-six miles from the Pacific coast, covers about 165 acres of land, and is about three feet deep. The water of this lake contains about 600 grains of borax to the gallon. Large crystals are formed at the bottom of this lake, from which several thousand tons are annually dug. Borax is found in many small lakes or ponds in Europe and in Peru, South America, being confined to volcanic regions.

THE MAMMOTH ORCHARD.

This orchard is located on a farm of 426 acres, about two miles south of Yuba City, in Sutter County, California. The above orchard contains 25,000 peach trees, 13,000 plum trees, 6,000 eastern walnut trees, 25,000 California walnut trees, 2,500 apple trees, 500 Italian chestnut tress, 3,000 cherry trees, of fifteen

varieties, which were all imported from Rochester, N. Y.; 2,000 plum trees, of twelve varieties, and 2,000 apricot trees, and 600 two-years old peach trees, making in all 79,600 fruit trees.

WONDERS OF THE WILDERNESS ON THE YELLOWSTONE.

The section of country about sixty miles square, lying partly in Montana, Idaho and Wyoming, is situated in an extensive basin, and is nearly 9,000 feet above the ocean; walled in by high and lofty mountains, the tops of which are covered with perpetual snow, and situated between 44 and 45 degrees north latitude, and between 33 and 34 degrees west longitude from Washington.

This basin contains thousands of volcanoes, geysers, sulphur springs, hot and mineral springs, and waterfalls the most magnificent on the globe.

The Yellowstone Lake, the source of the Yellowstone River, lies in the south part of this wonderful basin, and is about twenty miles square. The length of the river from the lake to where it unites with the Missouri River is 1,300 miles, and in that distance falls about 7,200 feet, has numerous romantic, and

the most magnificent falls yet discovered on the globe. The upper portion of this river flows through deep canyons, or gorges in the rocks, and is broken by immense cataracts and roaring rapids. One cataract is reported by the exploration in 1859, and by trappers and hunters, to fall 1,000 feet perpendicular. In this basin is found, at various points, some of the grandest and most romantic scenery on the continent.

The mountains surrounding this basin are very lofty, some as high as 10,580 feet, covered with pines and capped with perpetual snow. On the south-eastern side the rocks present to the beholder a precipitous wall several thousand feet in height. This wall of rock, and the steep and rocky sides of the mountain enclose this basin east, west and south, against all entrance to the basin in these directions. The only feasible entrance to the basin, is on the north through Montana. This country is entirely volcanic, and abounds in boiling springs, mud volcanoes, huge mountains containing sulphur, and geysers more extensive and numerous than those of Iceland.

Old mountaineers and trappers are great

romancers. Bridger, than whom perhaps no man has experienced more of wild mountain life, has been so much in the habit of embellishing his Indian adventures, that they are received by all who know him with many grains of allowance. The want of faith will account for the skepticism with which the oft repeated stories of the wonders of the upper Yellowstone River were received by people who had lived within one hundred and twenty miles of them; and who at any time could have established their verity by ten days' travel.

A company composed of some officials and leading citizens of Montana, felt that if the half was true, they would be amply compensated for all the troubles and hazards of an expedition to view the wonders in this marvelous basin It was, nevertheless a serious undertaking, and as the time drew near for our departure, several who had been foremost to join us, upon the receipt of intelligence that a large party of Indians had come into the Upper Yellowstone valley, found excuse for their withdrawal in various emergent occupations, so that when the day for our departure

arrived, our company was reduced in numbers to nine, and consisted of the following gentlemen: General H. D. Washburn, who served in the late war of the rebellion; Samuel T. Hanson, President of the First National Bank of Helena; Cornelius Hodges, a leading member of the bar of Montana; Hon. Truman C. Everts, late United States Assessor for Montana; Walter Trumbull, son of Senator Trumbull; Ben Stickney, Jr.; Warren C. Gillette; Jacob Smith, and Hon. George McDonald.

The preparation was simple—each man was supplied with a strong horse, well equipped with Califonia saddle, bridle and canteen. A needle-gun, a belt filled with cartridges, a pair of revolvers, a hunting-knife, added to the usual costume of the mountains, completed the personal outfit of each member of the expedition. When mounted and ready to start, they resembled more a band of brigands than sober men in search of natural wonders. Their provisions consisting of bacon, dried fruit, flour, &c., were securely lashed to the backs of twelve horses, which were placed in charge of a couple of packers or baggage masters. They also employed two colored boys as cooks.

Major-General Hancock, in favorable response to their application for a military escort, had given orders for a company of cavalry to accompany them, which they expected to join them at Fort Ellen in the Gallatin Valley—a distance of one hundred and twenty miles from Helena. They were none the less obliged to Gen. Hancock for his prompt compliance with their application for an escort, because of his own desire, previously expressed, to learn something of the country they were to explore, which would be of service to him in the disposition of the troops under his command for frontier defence; and if the result of their explorations in the least contributed to that end, they still remain the debtor of that officer for his courtesy and kindness, without which they might have failed altogether in their undertaking.

Their ride to Fort Ellis, through a well settled portion of the Territory, was accomplished in four days. That portion of the valleys of the Missouri and Gallatin Rivers through which they passed, dotted with numerous ranches, presented large fields of wheat, oats and potatoes, and other evidences of thrift common in

agricultural districts. Large droves of cattle were feeding upon the bunch grass which carpeted the valleys and foot-hills. Even the mountains, so wild, solemn and unsocial a few years ago, seemed to be domesticated as they reared their lofty summits in long and continuous succession along the bordering uplands.

At the three forks, where the Jefferson, Madison and Gallatin Rivers unite and form the Missouri, a thriving agricultural community has sprung up which must eventually grow into a town of considerable importance. Entering the magnificent valley of the Gallatin at this point, their course up the river lay through one of the finest agricultural regions on the continent.

The soil is remarkably fertile, and the valley stretches away on either side, a distance of twenty miles, to immense mountain ranges, which traverses its entire length, enclosing a territory as large as one of the larger New England States, every foot of which is susceptible of the highest cultivation.

Bozeman City, a village in Montana, is a picturesque village of 700 inhabitants, situated at the foot of the bell range of mountains, and

near the mouth of one of the mountain passes, through which the North Pacific Railroad is located. The village is neatly built of wood and brick. Its surroundings are magnificent. The eye can distinctly trace the mountains by which it is surrounded, a distance of 400 miles. Bozeman City will probably be the depot for visitors to stop at who are going to visit the basin of wonders and the head waters of the Yellowstone River and lake, now deep in the wilderness.

Fort Ellis, three miles distant, is built upon a table of land elevated above the village, and which overlooks the valley for a great distance. The party was welcomed by Colonel Baker, the commandant, and they pitched their tent near the fort. They were informed that, owing to the absence on duty of most of the soldiers, a fraction of a company—five cavalrymen and a lieutenant in command—were all that could be afforded for their escort; but realizing that a small body of white men could more easily elude a band of Indians than can a large party, and without hesitating to consider the possible defence which we could make against a war party of hostile Sioux Indians with this

limited number, they declared themselves satisfied and took their departure for the valley as fully assured of a successful journey as if their number had been multiplied by hundreds.

Their pack horses were brought up and their loads fastened to them with that incredible rapidity and skill which is the result only of life-long practice. The dexterity with which a skillful packer will load and unload his horses is remarkable. The rope is thrown around the body of the animal and securely fastened in less time than it takes to tell it.

Once under way, their little company, now increased to nineteen, presented quite a formidable appearance, our steeds gayly wheeled across the plain towards the mountains. After a tedious ride of several hours up steep acclivities, over rocks, and through dark defiles, they at length passed over the summit of the mountain range, took a last look of the beautiful valley of the Gallatin, and descended into a ravine coursed by the waters of Trail Creek. Following this two days, they came to the Yellowstone River, up which they rode to the solitary ranch of the brothers Boteler—the last abode of civilized man in the direction of

their travels. These hardy mountaineers received and entertained them in hearty mountain style, giving them the best of everything their ranch afforded, together with a great deal of information and advice about the country which they afterwards found to be invaluable. The Botelers belong to that class of pioneers of which there are many in the new Territories, who are only satisfied when their location and field of operations are a little in advance of civilization—exposed to privation and danger—and yet unite with these discomforts some advantages of hunting, trapping and fishing not enjoyed by men contented to dwell in safety. Free-hearted, jolly and brave, living upon such means as the country afforded, accustomed to roam for days and weeks in the mountains in pursuit of game and furs, their experience renewed their courage, and their descriptions which they gave of the wonders they had seen increased their curiosity. It was not pleasant, however, to learn that twenty-five lodges of Indians had gone up the valley a few days before their arrival, or to be told by a trapper whom they met that he had been robbed by them, and in common parlance, been

set on foot, by having his horse and provisions stolen. In anticipation of possible trouble from this source, they organized themselves and elected Gen. H. D. Washburn commander. It was understood they should make but one march each day—starting at 8 A. M., and camping at 3 P. M. This obviated the necessity of unpacking and cooking a dinner. At night the horses were to be carefully picketed, a fire built beyond them, and two of the company to keep guard until one o'clock; then to be relieved by two others, who were to watch until daylight. This divided the labor among fourteen, who were to serve as picket men twice each week. These precautionary measures being fully understood, they left Boteler's, plunging at once into the vast unknown which lay before them. Following the slight Indian trail, we traveled near the bank of the river amid the wildest imaginable scenery of river, rock and mountain. The foot-hills were covered with verdure, which an autumnal sun had sprinkled with maroon-colored tints, very delicate and beautiful. The path was narrow, rocky and uneven, frequently leading over high hills, in ascent and descent more or less

abrupt and difficult. The increasing altitude of the route was more perceptible than any over which they had ever traveled, and the river, whenever visible, was a perfect mountain torrent.

While descending a hill into one of the broad openings of the valley, their attention was suddenly arrested by half a dozen or more mounted Indians, who were riding down the foot-hills on the opposite side of the river. Two of their company, who had lingered behind, came up with the information that they had seen several more making observations from behind a small butte, from which they fled in great haste on being discovered. They soon rode down on the plateau to a point where their horses were hobbled, and for a long time watched the party as they continued their course of travel up the river. Our camp was guarded that night with more than ordinary vigilance. A hard rain storm which sat in early in the afternoon and continued through the night, may have saved them from an attack by these prowlers. When they started the next morning, General Washburn detailed four of our company to guard the pack train, while he, with four others, rode

in advance to make the most practicable selection of routes. Six miles above their camp they ascended the spur of a mountain, which came down boldly to the river's edge. From its summit they had a beautiful view of the valley stretched out before them—the river fringed with cottonwood trees—the foot-hills covered with luxuriant, many-tinted herbage, and over all the snow-crowned summits of the mountains, many miles away, but seemingly rising from the midst of the plateau at our feet. Looking up the river, the valley opened widely, and from the rock on which they stood was visible the train of pack-horses, slowly winding their way along the sinuous trail, which followed the inequalities of the mountain side. The whole formed a scene of great interest.

Pursuing their course a few miles further, they camped just below the lower canyon of the river. Their hunters provided them with a sumptuous meal of antelope, rabbit, grouse and trout. The night was very cold, the mercury standing at 40 degrees when they broke camp at eight o'clock the next morning.

They remained some time at the lower can-

yon of the Yellowstone, which, as a single isolated piece of scenery, is very beautiful. It is less than a mile in length, and perhaps does not exceed 1,000 feet in depth. Its walls are vertical, and seen from the summit of the precipice the river seems forced through a narrow gorge, and is surging and boiling at a fearful rate—the water breaking into millions of prismatic drops against every projecting rock. After traveling six miles over the mountains above the canyon, they again descended into a broad and open valley, skirted by a level upland for several miles. Here an object met their attention which deserves more than a casual notice. It was two parallel vertical walls of rock, projecting from the side of a mountain to the height of 125 feet, traversing the mountain from base to summit, a distance of 1,500 feet. These walls were not to exceed thirty feet in width, and their tops for the whole length were crowned with a growth of pines. The sides were as even as if they had been worked by line and plumb; the whole space between, and on either side of them having been completely eroded and washed away. They had seen many of the capricious

works wrought by erosion upon the friable rocks of Montana, but never before upon so majestic a scale. Here an entire mountain-side, by wind and water, had been removed, leaving as the evidence of their protracted toil, these vertical projections, which, but for their immensity, might as readily be mistaken for works of art as of nature. Their smooth sides, uniform width and height, and great length, considered in connection with the causes which had wrought their insulation, excited their wonder and admiration. They were all the more curious because of their dissimilarity to any other striking objects in natural scenery that they had ever seen or heard of. In future years, when the wonders of the Yellowstone are incorporated into the family of fashionable resorts, there will be few of its attractions surpassing in interest this marvelous freak of the elements. For some reason, best understood by himself, one of their companions gave to these rocks the name of the Devil's Slide. The suggestion was unfortunate, as with more reason perhaps, but with no better taste, they frequently had occasion to appropriate other portions of the person of his Satanic Majesty, or

of his dominion, in signification of the varied marvels they met with. Some little excuse may be found for this in the fact that the old mountaineers and trappers who preceded them had been peculiarly lavish in the use of the infernal vocabulary. Every river and glen and mountain had suggested to their imaginations some fancied resemblance to portions of a region which their pious grandmothers had warned them to avoid. It is common for them, when speaking of this region, to designate portions of its physical features, as Fire Hole Prairie, the Devil's Glen, Hell Roaring River, &c., and these names form a remarkable fitness of things, are not likely to be superseded by others less impressive. They camped at the close of this day's travel near the southwestern corner of Montana, at the mouth of Gardner's River.

Crossing this stream the next morning, they passed over several rocky ridges into a valley, which, for a long distance, was crowded with the spires of protruding rocks, which gave it such a dismal aspect that they named it The Valley of Desolation.

The trail was so rough and mountainous

that they were able to travel but six miles before the usual hour of camping. Much of the distance was through fallen timber, almost impassable by the pack train. A mile before camping they discovered on the trail the fresh tracks of unshod ponies, indicating that a party of Indians had recently passed over it. Lieut. Doane, with one of their company, had left the party in the morning, and did not come into camp that evening. One of their horses broke his lariat during the night and galloped through the camp, rousing the sleepers, who grasped their guns, supposing the Indians were really upon them. They started early the next morning, and soon struck the trail which had been traveled the preceding day by Lieut. Doane. It led over a more practicable route than the one they left. The marks made in the soil by the travaes (lodge poles) on the side of the trail showed that it had been recently traveled by a number of lodges of Indians—and a little colt, which we overtook soon after making the discovery, convinced them that they were in their immediate vicinity. Their party was separated, and if they had been attacked, their pack train, horses and stores

would have been an easy conquest. Fortunately they were unmolested, and when again united, made a fresh resolution to travel as much in company as possible. All precautionary measures, however, unless enforced by the sternest discipline, are soon forgotten—and danger, until actually impending, is seldom borne in mind. A day had scarcely passed when they were as reckless as ever. From the summit of a commanding range which separated the waters of the Antelope and Tower Creek, they descended through a picturesque gorge, leading their horses to a small stream flowing into the Yellowstone.

Four miles of travel, a great part of it down the precipitous slopes of the mountain, brought them to the banks of Tower Creek, and within the volcanic region, where the wonders were supposed to commence. On the right of the trail our attention was first attracted by a small hot sulphur spring, a little below the boiling point in temperature. Leaving the spring they ascended a high ridge, from which the most noticeable feature, in a landscape of great extent and beauty, was Column Rock, stretching for two miles along the eastern bank

ROCK PINNACLES ABOVE TOWER FALLS.

of the Yellowstone. At the distance from which they saw it, they could compare it in appearance to nothing but a section of the Giant's Causeway. It was composed of successive pillars of basalt overlying and underlying a thick stratum of cement and gravel resembling pudding stone. In both rows, the pillars, standing in close proximity, were each about thirty feet high and from three to five feet in diameter. This interesting object, more from the novelty of its formation and its beautiful surroundings of mountain and river scenery than anything grand or impressive in its appearance, excited their attention, until the gathering shades of evening reminded them of the necessity of selecting a suitable camp. They descended the declivity to the banks of Tower Creek, and camped upon a rocky terrace one mile distant from and four hundred feet above the Yellowstone. Tower Creek is a mountain torrent flowing through a gorge about forty yards wide. Just below their camp it falls perpendicularly over an even ledge 112 feet, forming one of the most beautiful cataracts in the world. For some distance above the fall the stream is broken into

a great number of channels, each of which has worked a tortuous course through a compact body of shale to the verge of the precipice, where they re-unite and form the fall. The countless shapes into which the shale has been wrought by the action of the angry waters, add a feature of great interest to the scene.

Spires of solid shale, capped with slate, beautifully rounded and polished, faultless in symmetry, raise their tapering forms to the height of from 80 to 150 feet all over the plateau above the cataract. Some resembling towers still shoot up as light and slender as the minerets of a mosque. Some of the loftiest of these formations, standing like sentinels upon the very brink of the fall, are accessible to an expert and adventurous climber. The position attained on one of their narrow summits, amid the uproar of waters, and at a height of 250 feet above the boiling chasm, as they can affirm, requires a steady head and strong nerves; yet the view which rewards the temerity of the exploit is full of compensation. Below the fall the stream descends in numerous rapids, with frightful velocity, through a gloomy gorge,

to its union with the Yellowstone. Its bed is filled with enormous boulders, against which the rushing waters break with great fury. Many of the capricious formations wrought from the shale excite merriment as well as wonder.

Of this kind, especially, was a huge mass sixty feet in height, which from its supposed resemblance to the proverbial foot of his Satanic Majesty, they called it the Devil's Hoof. The scenery of mountain, rock and forest surrounding the falls is very beautiful. Here, too, the hunter and fisherman indulge their tastes with the certainty of ample reward. As a half-way resort to the greater wonder still farther up the marvelous river, the visitor of future years will find no more delightful resting-place. No account of this beautiful fall has ever been given by any of the former visitors to this region. The name of Tower Falls, which they gave it, was suggested by some of the most conspicuous features of the scenery.

Early the next morning, several of the company left in advance, to explore a passage for the pack-train over the mountains, which were

very steep and lofty. They had been following a bend in the river, but as no sign of a change in its course was apparent, their object was, by finding a shorter route across the country, to avoid several days of toilsome travel. The advance party ascended a lofty peak—by barometrical measurement, was 10,550 feet above ocean level—which, in honor of their commander, was called Mount Washburn. From its summit, 400 feet above the line of perpetual snow, they were able to trace the course of the river to its source in Yellowstone Lake. At the point where they crossed the line of vegetation, the snow covered the side of the apex of the mountain to the depth of twenty feet, and seemed to be as solid as the rocks upon which it rested. Dscending the mountain, they came upon the trail made by the pack-train at its base, which they followed into camp at the head of a small stream flowing into the Yellowstone.

Following the stream in the direction of its mouth, at the distance of a mile below their camp, they crossed an immense bed of volcanic ashes, thirty feet deep, extending one hundred yards along both sides of the creek. Less than

a mile beyond, they suddenly came upon a hideous-looking glen filled with the sulphurous vapor emitted from six or eight boiling springs of great size and activity. One of their company aptly compared it to the entrance to the infernal regions. It looks like nothing earthly they had ever seen, and the pungent fumes which filled the atmosphere were not unaccompanied by a disagreeable sense of possible suffocation. Entering the basin cautiously, they found the entire surface of the earth covered with the incrusted sinter thrown from the springs. Jets of hot vapor were expelled through a hundred natural orifices with which it was pierced, and through every fracture made by passing over it. The springs themselves were as diabolical in appearance as the witches caldron in Macbeth, and needed but the presence of Hecata and her weird band to realize that horrible creation of poetic fancy. They were all in a state of violent ebullition, throwing their liquid contents to the height of three or four feet. The largest had a basin twenty by forty feet in diameter. Its greenish-yellow water was covered with bubbles, which were constantly rising, bursting and

emitting sulphurous gas from various parts of its surface. The central spring seethed and bubbled like a boiling caldron. Fearful volumes of vapor were constantly escaping it. Near it was another, not so large, but more infernal in appearance. Its contents, of the consistency of paint, were in constant, noisy ebullition. A stick thrust into it, on being withdrawn, was coated with lead-colored slime a quarter of an inch in thickness. Nothing flows from this spring; seemingly it is boiling down. A fourth spring, which exhibited the same physical features, was partly covered by an overhanging ledge of rock. They tried to fathom it, but the bottom was beyond the reach of the longest pole they could find. Rocks cast into it increased the agitation of its waters. There were several other springs in the group, smaller in size, but presenting the same characteristics. The approach to them was unsafe, the incrustation surrounding them bending in many places beneath their weight, and from the fractures thus created would ooze a sulphury slime of the consistency of mucilage. It was with great difficulty that they obtained specimens from the natural ap-

ertures with which the crust is filled—a feat which was accomplished by one only of their party, who extended himself at full length upon that portion of the incrustation which yielded the least, but which was not sufficiently strong to bear his weight while in an upright position, and at imminent risk of sinking into the infernal mixture, rolled over and over to the edge of the opening, and with the crust slowly bending and sinking beneath him, hurriedly secured the coveted prize. There was something so revolting in the general appearance of the springs and their surroundings, the foulness of the vapors, the infernal contents, the treacherous incrustation, the noisy ebullition, the general appearance of desolation, and the seclusion and wildness of the location, that, though awe-struck, they were reluctant to continue their journey without making them a second visit. They were probably never before seen by white man. The name of Hell Broth Springs, which they gave them, expressed our appreciation of their character.

Their journey the next day still continued through a country till then untraveled. Owing

to the high lateral mountain spurs, the numerous ravines, and the interminable patches of fallen timber, they made slow progress; but when the hour for camping arrived, they were greatly surprised to find themselves descending the mountain along the banks of the beautiful stream in the immediate vicinity of the Great Falls of the Yellowstone River. This stream, which we called Cascade Creek, is very rapid. Just before its union with the river it passes through a gloomy gorge, of abrupt descent, which on either side is filled with continuous masses of obsidian that have been worn by the water into many fantastic shapes and cavernous recesses. This they named the Devil's Den. Near the foot of the gorge the creek breaks from fearful rapids into a cascade of great beauty. The first fall of five feet is immediately succeeded by another of fifteen, into a pool as clear as amber, nestled beneath overarching rocks. Here it lingers as if half reluctant to continue its course, and then gracefully emerges from the grotto, and veiling the rocks down an abrupt descent of eighty-four feet, passes rapidly on to the Yellowstone. It received the name of Crystal.

The Great Falls are at the head of one of the most remarkable canyons in the world—a gorge through volcanic rock, fifty miles long, and varying from one thousand to nearly five thousand feet in depth. In its descent through this wonderful chasm, the river falls almost three thousand feet. At one point, where the passage has been worn through a mountain range, their hunters assured them it was more than a vertical mile in depth, and the river broken into rapids and cascades appeared no wider than a ribbon. The brain reels as you gaze into this profound and solemn solitude. Beholders shrink from the dizzy verge appalled, glad to feel the solid earth under their feet, and venture no more, except with forms extended, and faces barely protruding over the edge of the precipice. The stillness is horrible. Down, down, down, they see the river attenuated to a thread, tossing its miniature waves, and dashing with puny strength the massive walls which imprison it. All access to its margin is denied, and the dark gray rocks hold it in dismal shadow. Even the voice of its waters in their convulsive agony cannot be heard. Uncheered

by plant or shrub, obstructed with massive boulders and by jutting points, it rushes madly on its solitary course, deeper and deeper into the bowels of the rocky firmament. The solemn grandeur of the scene surpasses description; it must be seen to be felt. The sense of danger with which it impresses you is harrowing in the extreme. You feel the absence of sound, the oppression of absolute silence. If you could only hear that gurgling river, if you could see a living tree in the depth beneath you, if a bird would fly past, if the wind would move any object in the awful chasm, to break for a moment the solemn silence that reigns there, it would relieve that tension of the nerves which the scene has excited, and you would rise from your prostrate condition and thank God that he had permitted you to gaze unharmed, upon this majestic display of natural architecture. As it is, sympathizing in spirit with the deep gloom of the scene, you crawl from the dreadful verge, scared lest the firm rock give way beneath and precipitate you into the horrid gulf. They had been told by trappers and mountaineers that there were cataracts in this

vicinity a thousand feet high; but, if so, they must be lower down the canyon, in that portion of which by their journey across the bend in the river, they failed to see. They regretted, when too late, that they had not made a fuller exploration, for by no other theory than that there was a stupendous fall below them, or that the river was broken by a continued succession of cascades, could they account for a difference of nearly 3,000 feet in altitude between the head and mouth of the canyon. In that part of the canyon which they saw, the inclination of the river was marked by frequent falls fifteen and twenty feet in height, sufficient, if continuous through it, to accomplish the entire descent. The fearful descent into this terrific canyon was accomplished with great difficulty by Messrs. Hauser and Stickney, at a point about two miles below the falls. By trigonometrical measurement they found the chasm at that point to be 1,190 feet deep. Their ascent from it was perilous, and it was only by making good use of hands and feet, and keeping the nerves braced to the utmost, that they were enabled to clamber up the precipitous

rocks to a safe landing place. The effort was successfully made, but none others of the company were disposed to venture.

From a first view of the canyon they followed the river to the falls. A grander scene than the lower cataract of the Yellowstone was never witnessed by mortal eyes. The volume seemed to be adapted to all the harmonies of the surrounding scenery. Had it been greater or smaller it would have been less impressive. The river, from a width of two hundred feet above the falls, is compressed by converging rocks to one hundred and fifty feet, where it takes the plunge. The shelf over which it falls is as level and even as a work of art. The height, by actual line measurement, is a few inches more than 350 feet. It is a sheer, compact, solid, perpendicular sheet, faultless in all the elements of grandeure and picturesque beauties. The canyon which commences at the upper fall, half a mile above this cataract, is here a thousand feet in depth. Its vertical sides rise gray and dark above the fall to shelving summits, from which one can look down into the boiling spray-filled chasm, enlivened with rainbows, and glittering

like a shower of diamonds. From a shelf protruding over the stream, 500 feet below the top of the canyon, and 180 feet above the verge of the cataract, a member of their company lying prone upon the rock, let down a cord with a stone attached into the gulf, and measured its profoundest depths. The life and sound of the cataract, with its sparkling spray and fleecy foam, contrasts strangely with the sombre stillness of the canyon a mile below. There all was darkness, gloom and shadows; here all was vivacity, gayety and delight. One was the most unsocial, the other the most social scene in nature. They could talk, and sing, and whoop, waking the echoes with their mirth and laughter in presence of the falls, but they could not thus profane the silence of the canyon. Seen through the canyon below the falls, the river for a mile or more is broken by rapids and cascades of great variety and beauty.

Between the lower and upper falls the canyon is two hundred to nearly four hundred feet deep. The river runs over a level bed of rock, and is undisturbed by rapids until near the verge of the lower fall. The upper fall is entirely

unlike the other, but in its peculiar character equally interesting. For some distance above it the river breaks into frightful rapids. The stream is narrowed between the rocks as it approaches the brink, and bounds with impatient struggles for release, leaping through the stony jaws in a sheet of snow-white foam, over a precipice nearly perpendicular, 115 feet high. Midway in its descent the entire volume of water is carried, by the sloping surface of an intervening ledge, twelve or fifteen feet beyond the vertical base of the precipice, gaining therefrom a novel and interesting feature. The churning of the water upon the rocks reduces it to a mass of foam and spray, through which all the colors of the solar spectrum are reproduced in astonishing profusion. What this cataract lacks in sublimity is more than compensated by picturesqueness. The rocks which overshadow it do not veil it from the open light. It is up amid the pine foliage which crowns the adjacent hills, the grand feature of a landscape unrivalled for beauties of vegetation as well as of rock and glen. The two confronting rocks overhanging the verge at the height of a hundred feet or

more, could be readily united by a bridge, from which some of the grandest views of natural scenery in the world could be obtained, while just in front of, and within reaching distance of the arrowy water, from a table one-third of the way below the brink of the fall, all its nearest beauties and terrors may be caught at a glance. They rambled around the fall and canyon two days, and left them with the unpleasant conviction that the grandest wonder of their journey had been seen. They indulged in a last and lingering glance at the falls on the morning of the first day of Autumn. The sun shone brightly, and the laughing waters of the upper fall were filled with the glitter of rainbows and diamonds. Nature, in the excess of her prodigality, had seemingly determined that this last look should be the brightest, for there was everything in the landscape, illuminated by the rising sun, to invite a longer stay. Even the dismal canyon, so dark, and gray, and still, reflected here and there on its vertical surface patches of sunshine, as much as to say, "see what I can do when I try." Everything had put a jocund humor on. Long vistas of light

broke through the pines which crowned the contiguous mountains, and the snow-crowned peaks in the distance glistened like crystals. Catching the spirit of the scene, we laughed and sung, and whooped, as we rambled hurriedly from point to point, lingering only when the final moment came to receive the very last impressions.

At length they turned their backs upon the scene, and wended their way slowly up the river bank, along a beautiful trail. The last vestige of the rapids disappeared at the distance of half a mile above the upper fall. The river, expanded to the width of 400 feet, rolled peacefully between low verdant banks. The water for some distance was of that emerald hue which is so distinguishing a feature of Niagara. The bottom was pebbly, and but for the treacherous quicksands and crevices, of which it was full, we could easily have forded the stream at any point between the falls and their camping place. They crossed a little creek strongly impregnated with alum, and three miles beyond found themselves in the midst of volcanic wonders of great variety and profusion. The region

was filled with boiling springs and craters. Two hills, each 300 feet high, and from a quarter to half a mile across, had been formed wholly of the sinter thrown from adjacent springs—lava, sulphur and reddish-brown clay.

Hot streams of vapor were pouring from crevices scattered over them. Their surfaces answered in hollow intonations to every footstep, and in several places yielded to the weight of their horses. Steaming vapor rushed hissingly from the fractures, and all around the natural vents large quantities of sulphur in crystallized from, perfectly pure, had been deposited. This could be readily gathered with pick and shovel. A great many exhausted craters dotted the hill-side. One near the summit, still alive, changed its hues like steel under the process of tempering, to every kiss of the passing breeze. The hottest vapors were active beneath the incrusted surface everywhere. A thick leathern glove was no protection to the hand exposed to them. Around these immense thermal deposits, the country, for a great distance in all directions, is filled with boiling springs, all exhibiting separate characteristics. The most conspicu-

ous of the cluster is a sulphur spring twelve by twenty feet in diameter, encircled by a beautifully scolloped sedimentary border, in which the water is thrown from three to seven feet. The regular formation of this border, and the perfect shading of the scollops forming it, are among the most delicate and wonderful freaks of nature's handiwork. They look like an elaborate work of art. This spring is located at the western base of Crater Hill, above described, and the gentle slope around it for a distance of 300 feet is covered to considerable depth with a mixture of sulphur and brown lava. The moistened bed of a small channel, leading from the spring down the slope, indicated that it had recently overflowed. A few rods north of this spring, at the base of the hill, is a cavern whose mouth is about seven feet in diameter, from which a dense jet of sulphurous vapor explodes with a regular report like a high-pressure engine. A little further along they came upon another boiling spring, seventy feet long by forty feet wide, the water of which is dark and muddy, and in unceasing agitation.

About a hundred yards distant they dis-

covered a boiling alum spring, surrounded with beautiful crystals, from the border of which they gathered a quantity of alum, nearly pure, but slightly impregnated with iron. The violent ebullition of the water had undermined the surrounding surface in many places, and for the distance of several feet from the margin had so thoroughly saturated the incrustation with its liquid contents, that it was unsafe to approach the edge. As one of their company was unconcernedly passing near the brink, the incrustation suddenly sloughed off beneath his feet. A shout of alarm from his comrades aroused him to a sense of his peril, and he only avoided being plunged into the boiling mixture by falling suddenly backward at full length upon the firm portion of the crust, and rolling over to a place of safety. His escape from a horrible death was most marvelous, and in another instant he would have been beyond all human aid. Their efforts to sound the depths of this spring with a pole thirty-five feet in length, were fruitless.

Beyond this they entered a basin covered with the ancient deposit of some extinct

crater, which contained about thirty springs of boiling clay. These unsightly caldrons varied in size from two to ten feet in diameter, their surfaces being from three to eight feet below the level of the plain. The contents of most of them were of the consistency of thick paint, which they greatly resembled; some being yellow, others pink, and others dark brown. This semi-fluid was boiling at a fearful rate, much after the fashion of a hasty pudding in the last stages of completion. The bubbles, often two feet in height, would explode with a puff, emitting at each time a villainous smell of sulphuretted vapor. Springs six and eight feet in diameter, but four feet asunder, presented distinct phenomenal characteristics; there was no connection between them above or below.

The sediment varied in color, and not unfrequently there would be an inequality of five feet in their surfaces. Each, seemingly, was supplied with a separate force. They were embraced within a radius of 1,200 feet, which was covered with a strong incrustation, the various vents in which emitted streams of heated vapor. Their silver watches, and other

metallic articles, assumed a dark leaden hue. The atmosphere was filled with sulphurous gases, and the river opposite their camp was impregnated with the mineral bases of adjacent springs.

The valley through which they had made their day's journey was level and beautiful, spreading away to grassy foot-hills which terminated in a horizon of mountains. They spent the next day in examining the wonders surrounding them. At the base of adjacent foot-hills they found three springs of boiling mud, the largest of which, forty feet in diameter, encircled by an elevated rim of solid tufa, resembles an immense caldron. The seething, bubbling contents, covered with steam, are five feet below the rim. The disgusting appearance of this spring is scarcely atoned for by the wonder with which it fills the beholder. The other two springs, much smaller, but presenting the same general features, are located near a large sulphur spring of milder temperature, but too hot for bathing. On the brow of an adjacent hillock, amid the green pines, heated vapor issues in scorching jets from several craters and fissures.

Passing over the hill they struck a small stream of perfectly transparent water, flowing from a cavern, the roof of which tapers back to the water which is boiling furiously at a distance of twenty feet from the mouth, and is ejected through it in uniform jets of great force. The sides and entrance of the cavern are covered with soft green sediment, which renders the rock on which it is deposited as soft and pliable as putty.

About two hundred yards from this cave is a most singular phenomenon, which they call the Muddy Geyser. It presents a funnel-shaped orifice, in the midst of a basin one hundred and fifty feet in diameter, with sloping sides of clay and sand. The crater, at the surface, is thirty by fifty feet in diameter. It tapers quite uniformly to the depth of about thirty feet, where the water may be seen when the geyser is in repose, presenting a surface of six or seven feet in breadth. The flow of this geyser is regular every six hours. The water rises gradually, commencing to boil when about half way to the surface, and occasionally breaking forth in great violence. When the crater is filled it is expelled from it

in a splashing, scattered mass, ten or fifteen feet in thickness, to the height of forty feet. The water is of a dark lead color, and deposits the substance it holds in solution in the form of miniature stalagmites upon the sides and top of the crater. As this was the first object which approached a geyser, they naturally enough regarded it with intense curiosity. The deposit contained in the water of this geyser comprises about one-fifteenth of its bulk, and an analysis of it, made by Professor Augustus Steitz, of Montana, gives the following result: silica, 36.7; alumina, 52.4; oxide of iron, 1.8; oxide of calcium, 3.2; oxide of magnesia, 1.8; soda and potassa, 4.1–100.

While returning by a new route to their camp, dull thundering sounds, which General Washburn likened to frequent discharges of a distant mortar, broke upon their ears. They followed their direction and found them to proceed from a mud volcano, which occupied the slope of a small hill, embowered in a grove of pines. Dense volumes of steam shot into the air with each report, through a crater thirty feet in diameter. The reports, though irregular, occurred as often as every five sec-

onds, and could be distinctly heard half a mile. Each alternate report shook the ground a distance of two hundred yards or more, and the massive jets of vapor which accompanied them burst forth like the smoke of burning gunpowder. It was impossible to stand on the edge of that side of the crater opposite the wind, and one of their party, Mr. Hodges, was rewarded for his temerity in venturing too near the rim, by being thrown by the force of the volume of steam violently down the outer side of the crater. From hasty views afforded by occasional gusts of wind they could see, at a depth of sixty feet, the regurgitating contents.

This volcano, as is evident from the freshness of the vegetation, and the particles of dried clay adhering to the topmost branches of the trees surrounding it, is of very recent formation. Probably it burst forth a few months ago. Its first explosion must have been terrible. They saw limbs of trees 125 feet high, encased in clay, and found its scattered contents two hundred feet from it. They closed this day's labor by a visit to several other springs, so like those already de-

scribed that they require no special notice. Hon. G. McDonald, in company with General Washburn, rode back three miles the next morning to resurvey Crater Hill, and the springs in its vicinity. The large sulphur spring was overflowing and boiling with greater fury than on the previous visit, the water occasionally leaping ten feet high. Fording the river a short distance above the camp, we found the first evidence, since leaving Boteler's, that the country had long ago been visited by trappers and hunters. It was a bank of earth two feet high, presenting an angle to the river, ingeniously concealed by interwoven willows, thus forming a rifle-pit, from which the occupant, without discovery, could bring down geese, ducks, swans, pelicans, and the numerous furred animals with which the river abounds. Near by we stopped a moment, and then proceeded through artemisia (sage brush), ravines, and small meadows, into a dense forest of pines, filled with prostrate trunks, which had piled upon each other for years, to the height of many feet. Our passage of two miles through this forest to the bank of the lake, unmarked by any trail, was

accomplished with great difficulty, but the view which greeted them at its close was amply compensatory.

There lay the silvery bosom of the lake, reflecting the beams of the setting sun, and stretching away for miles, until lost in the dark foliage of the interminable wilderness surrounding it.

Secluded amid the loftiest peaks of the rocky mountains, 8,337 feet above the level of the ocean, possessing strange peculiarities of form and beauty, this watery solitude is one of the most attractive natural objects in the world. Its southern shore, indented with long, narrow inlets, not unlike the frequent fiords of Iceland, bears testimony to the awful upheaval and tremendous force of the elements which resulted in its creation. The long pine-crowned promontories, stretching into it from the base of the hills, lend new and charming features to an aquatic scene full of novelty and splendor. Islands of emerald hue dot its surface, and a margin of sparkling sand form its jeweled setting. The winds, compressed in their passage through the mountain gorges, lash it into a sea as terrible as the

fretted ocean, covering it with foam. But now it lay before us, calm and unruffled, save by the gentle wavelets which broke in murmurs along the shore. Water, one of the grandest elements of scenery, never seemed so beautiful before. It formed a fitting climax to all the wonders they had seen, and they gazed upon it for hours, entranced with its increasing attractions.

This lake is about twenty-five miles long, and seventy-five or eighty miles in circumference. Doubtless it was once the mighty crater of an immense volcano. It is filled with trout, some of gigantic size and peculiar delicacy. Water fowl, in great variety, dot in flocks its mirrored surface. The forests surrounding it are filled with deer, elk, mountain sheep, and lesser game; and in the mountain fastnesses the terrible grizzly and formidable amiss make their lairs. In form, the lake was, by one of their party, not inaptly compared to the human hand, with the fingers extended and spread apart as much as possible. The main portion of the lake is the northern, which would represent the palm of the hand. There is a large southwest bay, nearly cut off,

that would represent the thumb, while there are about the same number of narrow southern inlets as there are fingers on the hand.

Enclosing this watery palm, is a dense forest of pines, until now untraversed by man. It was filled with trunks of trees in various stages of decay, which had been prostrated by the mountain blasts, rendering it almost impassable; but as the beach of the lake was in many places impracticable, there was no alternative but to recede altogether, or work our way through it. Our course for the first six miles lay along the beach, passing a number of hot sulphur springs and lukewarm ponds. There steam jets, from incrusted apertures, discharged with a hissing noise, resembling the sound of steam escaping from an engine. The water of the lake was thoroughly impregnated with sulphur, and the edges at a distance of twenty to twenty-five feet from the beach, bubbled with springs which, like those on the bank, discharged through pipes of silicious sinter. These pipes, though completely submerged, were intensely hot, while the water of the lake was too cold for a pleasant bath.

At one point along the shore are scattered curiously wrought objects of slate, varying in size from a gold dollar to a locomotive. They gathered specimens of cups which had been hollowed out by the elements—discs, long pestles, resemblances to legs and feet, and many other objects which nature in her most capricious mood had scattered over this watery solitude. So strikingly similar were many of these configurations to works of art, that a fanciful old trapper who had seen them told them that they would find on the borders of the lake the drinking-cups, stone war clubs, and remains of the idols of an extinct race which had once dwelt there. These were doubtless the joint productions of fire and water, the former roughly fashioning, and the latter beautifully polishing and depositing them where they could be easily obtained. They gave to this locality the name of Curiosity Point, and added to their collection a number of specimens from its ample store.

Ascending the plateau from the beach, they became at once involved in all the intricacies of a primeval wilderness of pines. Difficulties increased with their progress through

it, severely trying the amiability of every member of the company. Their pack-horses would frequently get wedged between the trees, or caught in the traps of a net-work of fallen trunks, from which labor, patience and ingenuity were severely taxed to extricate them. The ludicrous sometimes came to our relief, proving that there was nothing so effectual in allaying excitement as hearty laughter. They had a remarkable pony in their pack train, which, from the moment they entered the forest, by his numerous acrobatic performances and mishaps, furnished amusement for the company. One part of the process of travel through this forest could only be accomplished by leaping over the fallen trunks, an exploit which, with all the spirit needful for the purpose, their little broncho lacked the power always to perform. As a consequence he was frequently found with the feat half accomplished, resting upon the midriff, his fore and hind feet suspended over the opposite sides of some huge log. His ambition to excel was only equaled by the patience he exhibited in difficulty. On one occasion, while clambering a steep rocky ascent, his head overtopping

his haunches, he literally performed three of the most wonderful backward headsprings ever recorded in equine history. A continued experience of this kind, after three weeks toilsome travel, found him as sound as on the day of its commencement, and they named him the Little Invulnerable. After fifteen miles of unvarying toil, they emerged from the forest to the pebbly beach of the lake. Here they found cornelians, agates and chalcedony in abundance. The lake was rolling tumultuously, its crested waves rising at least four feet high. The scene was very beautiful and exhilarating.

Their route the next day was divided between the beach of the lake and the forest, and so much impeded by fallen timber, that they traveled but ten miles. Part of this distance was along the base of a brimstone basin, which stretched from the lake to a semi-circular range of mountains.

In company with Lieutenant Doane, Hon. G. McDonald ascended this range, traversing its slopes a distance of three or four miles, and found it covered half-way to the summit with a mixture of carbonate of lime and

flowers of sulphur. Exhalations issuing from all parts of the surface, impregnated the atmosphere with sulphurous odors. Small rivulets of warm water, holding sulphur in solution, coursed their way down the mountain, uniting at its foot in a considerable stream. The surface over which they rode was strongly incrusted, and sounded hollow beneath the tread of the horses. It was filled with vents and fissures, surrounded with sulphur deposits nearly washed away. This mountain exhibited the same general phenomena as Crater Hill, though not in an equal state of activity. Their course on the following day was nearly south-east, on a line parallel with the Wind River Mountains, that remarkable range which forms so conspicuous a feature in Mr. Irving's Astoria, and Bonneville's Adventures. The faint outline of their distant peaks had been visible on the north-eastern horizon for several days. On their right, seventy-five miles distant, were the towering summits of the Three Tetons, the land-marks of the Snake River Valley. The close of the day, on September 6th, found them near the south-eastern arm of the lake, into which a large river flows. The

ground was low and marshy, and being unable to find a fording-place, they were compelled to make their camp at the base of a range of bluffs, half a mile away. During the night they were startled by the shrill and almost human scream of an amiss, or mountain lion, which sounded uncomfortably near. This terrible animal is much larger than the panther of the eastern forests, but greatly resembles it in shape, color and ferocity. It is the terror of mountaineers, and furnishes them with the staple for many tales full of daring exploits. Early the next morning, their commander and several others left camp in search of a ford, while Mr. McDonald and Lieutenant Doane started in the direction of a lofty mountain, from the summit of which they expected to obtain a satisfactory observation of the southern shore of the lake. At the expiration of two hours they reached a point in the ascent too precipitous for further equestrian travel. Dismounting they led their horses for an hour longer up the steep sides of the mountain, pausing every few minutes to take breath, until they arrived at the line of perpetual snow. Here they unsaddled and

hitched their horses, and climbed the apex to its summit, passing over a mass of congealed snow more than thirty feet in thickness. The ascent occupied four hours. They were more than 600 feet above the snow line, and by barometric calculation, 11,350 feet above the ocean level.

The grandeur and vast extent of the view from this elevation beggars description. The lake and valley surrounding it lay seemingly at their feet, within jumping distance. Beyond them they saw with great distinctness the jets of the mud volcano and geyser. But beyond all these, stretching away into a horizon of cloud-defined mountains, was the entire Wind River range, revealing in sunlight the dark recesses, gloomy canyons, stupendous precipices, and glancing pinnacles, which everywhere dotted its jagged sides. Lofty peaks shot up in gigantic spires from the main body of the range, glittering in the sunbeam like solid crystal. The mountain on which they stood was the most westerly peak of a range which, in long extended volume, swept to the south-eastern horizon, exhibiting a continuous elevation more than thirty miles in width;

its central line broken into countless points, knobs, glens and defiles, on the most colossal scale of grandeur and magnificence.

Outside of these, on either border, along the entire range, lofty peaks rose at intervals, seemingly vieing with each other in the varied splendors they presented to the beholder. The scene was full of majesty. The valley, at the base of this range, was dotted with small lakes, and cloven centrally by the river, which, in the far distance, they could see emerging from a canyon of immense dimensions, within the shade of which two enormous jets of steam shot to an incredible height into the atmosphere. This range of mountains has a marvelous history. As it is the loftiest, so it is the most remarkable lateral ridge of the Rocky Range. The Indians regard it as the crest of the world, and among the Blackfeet there is a fable that he who attains its summit catches a view of the land of souls, and beholds the happy hunting grounds spread out below him, brightening with the abodes of the free and generous spirits. In the expedition sent across the continent by Mr. Astor, in 1811, under command of Captain

Wilson P. Hunt, that gentleman met with the first serious obstacle to his progress at the base of this range. After numerous efforts to scale it, he turned away and followed the valley of the Snake River, encountering the most discouraging disasters until he arrived at Astoria. Later, in 1833, the indomitable Captain Bonneville was lost in this mountain labyrinth, and after devising various modes of escape, finally determined to ascend the range. Selecting one of the highest peaks, in company with one of his men, Mr. Irving says: After much toil, he reached the summit of a lofty cliff, but it was only to behold gigantic peaks rising all around, and towering far into the snowy region of the atmosphere. He soon found that he had undertaken a tremendous task; but the pride of man is never more obstinate than when climbing mountains. The ascent was so steep and rugged that he and his companions were frequently obliged to clamber on hands and knees, with their guns slung upon their backs. Frequently, exhausted with fatigue, and dripping with perspiration, they threw themselves upon the snow, and took handfuls to allay their parch-

ing thirst. At one place they stripped off their coats and hung them upon the bushes, and thus lightly clad proceeded to scramble over those eternal snows. As they ascended still higher, there were cool breezes that refreshed and braced them, and springing with new ardor to their task, they at length attained the summit.

As late as 1860, Captain Reynolds, the commander of the expedition, sent by the Government to explore the Yellowstone River, from his camp at the base of this formidable range, writes: To our front, and upon the right, the mountains towered above us to the height of from 3,000 to 5,000 feet, in the shape of bold, craggy peaks of basaltic formation, their summits crowned with glistening snow. It was the original desire to go from the head of Wind River to the head of the Yellowstone, keeping on the Atlantic slopes, thence down the Yellowstone, passing the lake, and across by the Gallatin River to the three forks of the Missouri. Bridger said at the outset that this would be impossible, and that it would be necessary to pass over to the head waters of the Columbia River, and back

again to the Yellowstone. They had not previously believed that crossing the main crest twice would be more easily accomplished than the transit over what was in effect only a spur, but the view from their camp (head of Wind River,) settled the question adversely to their opinion at once. Directly across their route lies a basaltic ridge, rising not less than 5,000 feet above them, its walls apparently vertical, with no visible pass or even a canyon. On the opposite side of this are the head waters of the Yellowstone. They were an hour and a half making the descent of the mountain. At its base they struck the trail of their pack-train, which they followed to a point where the direction it had taken would have been lost, but for the foresight of one of their companions, who had formed a tripod of poles, one of which, longer than the rest, pointed to the right. Obeying this Indian indication, they descended the bank and crossed the bottom of the river; fording it, they followed the trail through a beautiful pine forest, free from undergrowth and other obstructions, the distance of a mile. Here night overtook them, and mistaking for the trail a dark ser-

pentine line, they found themselves clambering up the side of a steep mountain. The conviction that they were following a band of Indians, and possibly were near their lodges, suggested no pleasant reflections. Alighting from their horses, they built a fire upon the track, and carefully examining it could not find the impression of a single horse shoe. Further investigation revealed the fact that they had been for some time pursuing the path worn by a gang of elk that had crossed the trail of the pack-train since the twilight set in. A night on the mountain, without supper or blankets, was not to be endured. They retraced their route to the base of the mountain, and struck out boldly in the darkness for the beach of the lake, where they supposed their party had camped. Their ride through fallen timber and morass until they reached the shore, was performed more skillfully than if they had seen the obstacles which lay in their path. They reached the lake in safety, and after a ride of two miles on the smooth beach, rounded a point from which they saw the welcome watch-fires of their company. A loud halloo was responded to by a dozen

sympathetic voices, showing that their anxiety had been shared by their companions. Their camp was on the eastern inlet of the south shore of the lake, distant but four miles from the camp of the preceding night. Thirteen miles of toilsome travel, zizagged into only seven of progress, found us encamped, at the close of the next day, two miles from the mouth of a small stream flowing into the lake. Their party was separated nearly all day, searching for routes. Two members, after suffering all the early sensations incident to a conviction of being lost in the wilderness, came into camp at a late hour, full of glee at their good fortune. At one of their halts, after they had dismounted to reconnoitre, a huge grizzly bear jumped at one of them from the bushes, frightening his horse so that he broke his bridle and ran away. They caught him without difficulty. Their commander and Mr. Hauser, in company, while seeking a route for future travel, came suddenly upon a female grizzly bear and two cubs, about half a mile from camp. On their return, six of the party started in pursuit, but Madam Bruin, meanwhile, had made good her retreat.

Their journey of five miles, the next day, was accomplished with great difficulty and annoyance. Almost the entire distance was through a forest piled full of fallen trunks. Traveling was but another name for scrambling; and as man is at times the least amiable of animals, their tempers frequently displayed alarming activity, not only toward the patient creatures laden with their stores, but toward each other.

Once, while involved in the reticulated meshes of a vast net of branches and tree-tops, each man, with varied expletive emphasis, clamorously insisting upon a particular mode of extrication, a member of the party, who was always jolly, restored them to instant good humor by repeating, in theatrical tone and manner, those beautiful lines from Childe Harold:

> "There is a pleasure in the pathless woods,
> There is a rapture on the lonely shore."

Their Little Invulnerable, too, was the unconscious cause of many bursts of laughter, which, like the appreciative plaudits of an audience, came in at the right time. They were glad, however, at an early hour in the

afternoon, to pitch their tent on one of the small tributaries of the Snake River, three miles distant from the lake. In the search made by every member of the party for routes, our company was unavoidably much scattered. Their first care being for the pack-train, the little animal whose frequent mishaps had been to them all a souce of so much amusement, was missing. An instant search was instituted, and at a late hour they found him three miles from camp. He saluted them with a low neigh, and with hurried pace soon rejoined his companions. One of their comrades (the Hon. Truman C. Evarts, late U. S. Assesor of Montana,) had failed to come up with the rest of the company; but as this was a common circumstance, we gave it little heed until the lateness of the hour convinced them he had lost his way. They increased their fire and fired their guns as signals, but all to no purpose. It had been a sort of tacit agreement among them only the night before, that should any one get parted from the company, he would at once go to the south-west arm of the lake, (that being our objective point,) and await there the arrival of the train.

The belief that we should find our companion there, hastened them into the commission of an error, which was designed by all as a measure of speedy relief. If they had not continued their journey with all possible expedition towards the point indicated, Mr. Evarts would probably have rejoined them within three or four days, as he informed them since, that he visited their camp, but the falling foliage of the pines had entirely obliterated their departing trail. The narrative of this gentleman, of thirty-seven days spent in this terrible wilderness, will furnish a chapter in the history of human endurance, exposure and escape, as incredible as it must be painfully instructive and entertaining.

Seven miles of struggling took us through the timber to another inlet, five miles farther on our way. No sign of their missing comrade. They built a large fire on a commanding ridge, and ascended a mountain overlooking the north and west shores of the lake, where they kindled another fire, which could be seen at a great distance. Eight hundred feet above Yellowstone Lake, nestled in a dark mountain glen, they found two small lakes, completely

environed with frightful masses of basalt and brown lava, seemingly thrown up and scattered by some terrible convulsion.

Two of their company took the backward trail at night, searching for Mr. Evarts; and our anxieties were greatly increased lest they, too, should meet with some disaster. They rose early the next morning, after passing a sleepless night. While at breakfast their two companions came in. They had followed the beach to a point east of their camp of two days before, and found no trace of Mr. Evarts. More than ever assured that they should find him at the west arm of the lake, they struck out for that point, three of their party, Mr. Hauser, Lieut. Doane and Mr. G. McDonald, in advance, to explore a route for the train, and make all possible search by the way. They posted notices on the trees to indicate the route they had taken, and made caches of provisions at several points. Late in the afternoon, at the close of a fatiguing day's travel, mostly through forest, they arrived at their objective point and were greatly distressed to find there no trace of their lost friend. While gathered around their camp-

fire in the evening, devising a plan for more systematic search, their ears were saluted with a screech so terribly human, that, for a moment, supposing it to be their missing comrade, they hallooed in response, and would have started to his relief but that a minatory growl warned them of the near approach of a mountain lion. Three parties, of two each, struck out the next morning in different directions, in pursuit of their companion. One followed the lake shore; one the back trail through the forest; and the third, southerly from the lake to a large brown mountain. The party following the lake shore returned to camp early in the afternoon, with the report that they had seen Indians. The story of their adventures, written by one of them, runs thus: He and his companion having penetrated several miles through the inhospitable wilds of that region, dismounted and unsaddled their horses. Mr. T. commenced to fish, and prepare them a little dinner, while Mr. S. went ahead with his gun, to continue the search on foot. The former had just caught four fishes, and kindled a fire, when the latter returned in some haste, but perfectly cool and self-possessed, and

stated that there were six Indians on a point jutting out into the lake, about a mile distant. They concluded that neither had a mouth for fish, which they left sweltering in the noon-day sun, and saddling their horses, they advanced towards the foe. Mr. S. saw them distinctly; but Mr. T. could not, probably because he was somewhat near-sighted. Finally, the former gentleman saw them flitting, phantom-like, among the rocks and trees, at which juncture the party retired to camp in platoons, and in good order, at the rate of a mile in every three minutes. This tribe of Indians, being one of the curiosities of the expedition, and hitherto unknown, was named after the person who discovered it. Both of the other parties returned, after a fruitless search. In their trip to the brown mountain, the two who went south crossed the main range of the Rocky Mountains, through a very low pass, which on the western side terminated in a brimstone basin, containing forty or fifty sulphur and mud springs, and a large number of craters, from which issued jets of vapor. This slope of the mountains was covered with a hollow incrustation through which the

water from the springs, percolating in different channels, had spread out over the little patches of soil with which they came in contact, covering them with bright green verdure. In crossing one of these, the horse of one of the party broke through to his haunches, and being extricated, he plunged more deeply into another trap, throwing headlong his rider, whose arm, as he fell, was thrust violently through the treacherous surface into the scalding morass, from complete submersion in which, both man and beast were with great difficulty saved.

At the base of the brown mountain the party saw a lake of considerable size, which they believed to be the head waters of Snake River—the Lewis Fork of the Columbia River. They could not approach it nearer than a mile, on account of the treacherous character of the soil. The other party were absent two days. They had visited all the camps of the six preceding days, following the trail between them, mostly obliterated by the falling foliage of the pines, with great difficulty, but without discovering the slightest indication that Mr. Evarts had come upon it.

On full consultation, they came to the conclusion that he had either been shot from his horse by an Indian, or had returned down the Yellowstone, or struck out upon some of the head waters of Snake River, with the intention of following it to the settlements. It was agreed that they should pursue the search three days longer from this point before renewing their journey. Snow began to fall early in the evening. Through the hazy atmosphere they beheld, on the shore of the inlet, opposite the camp, the steam ascending in jets from more than fifty craters, giving it much the appearance of a New England factory village. Snow continued to fall all night and the next day, and they made their camp as comfortable as possible. At night the snow was more than two feet deep. It turned to rain the following morning. Showers alternating with sunshine during the day, removed the snow rapidly. They were now so completely environed by forest, and so far from any recognized trail, that all their fears of molestation by Indians, or of danger from any other cause, was thoroughly dissipated. With true Falstaffian philosophy, they felt

they could take their ease in their inn, and the figure one of them presented has been graphically delineated by their artist on the spot.

They made a circuit round the head of the inlet to the springs they had seen the day previous. They were widely different from any they had visited before. In all, they numbered 150, and were scattered along the lake shore about a mile, at a distance of 100 yards from the beach. Those farthest inland resembled boiling mud, of various degrees of consistency; some not thicker than paint, others so dense that as they boiled over, the contents piled into heaps, which gradually spread over the ground, forming an extensive vitrified surface. This sediment varies in color—that flowing from some of the apertures being white as chalk, that from others of a delicate lavender hue, and from others, a brilliant pink color. The following are the results of analyses of the various specimens which they gathered, by Professor Augustus Steitz, of Montana:

White Sediment,		Lavender Sediment.		Pink Sediment.	
Silica	42.2	Silica	28.2	Silica	32.6
Magnesia	33.4	Alumina	58.6	Alumina	52.4
Lime	17.8	Boraic Acid	3.2	Oxide Calcium.	8.3
Alkalies	6.6	Oxide of Iron	0.6	Soda & Potassa	4.2
		Oxide Calcium.	4.2	Water and Loss	2.5
		Water and Loss	5.2		
	100.0		100.0		100.0

In close proximity to the springs are others of pure, odorless water. Near the shore were several boiling springs, around which the sedimentary increment had formed into mounds of various sizes and heights. The deposit around one of these springs resembles a miniature forest of pines. The most remarkable springs in this group, six or seven in number, are of pure ultamarine hue, very large, and wonderfully transparent. The largest is forty feet wide by seventy feet long. The sides are funnel-shaped, converging regularly to the depth of forty feet, where they present a dark and apparently unfathomable chasm. From the surface to this opening the sides of the funnel are furrowed and sinuous, coated with a white sediment, which contrasts vividly with the dark orifice at its base.

This group of springs exhibit in their deposit a great variety of shades and colors,

no two of them being alike. Their constant overflow has furnished a concrete bank of commingled tufa, eight feet in height, and a quarter of a mile in length, on the margin of the lake. The waves have worn this bank into large caverns, which respond in hollow murmurs to their fierce assaults. Between the springs are numerous vents and craters, from which heated vapor is constantly rising. Along the edge of the water, and ten or twenty feet from the shore, many springs are bubbling, none of which seem to be strongly impregnated with sulphur. The beach, for a mile or more, is strewn with fragments of sinter of various colors, which have been worn by the waves into many fantastic forms.

The five days during which they camped at this location, were occupied by every possible effort to find their missing friend, but the labors of each day only served to increase their fears for his safety. One hope, that of meeting him at Virginia City, was still indulged; but opposed to this were many painful conjectures as to his possible fate—not the least prevalent of which was the one that he might have been shot from an ambush

by an Indian arrow. Their provisions were rapidly diminishing, and their longer stay gave promise of unfavorable results. The force of circumstances obliged them to adopt the gloomy alternative of moving forward the next day, leaving one of their own party and two of the cavalrymen to prosecute a further search.

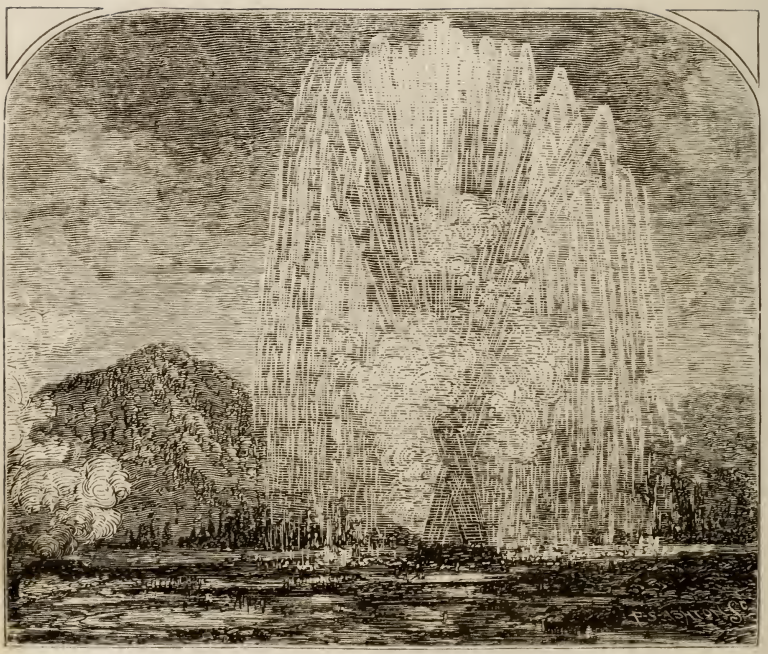
The loss of their comrade and friend was to them a source of much unhappy reflection, and the hope of finding him so entirely absorbed their attention, that they had little curiosity to examine, and so escaped very many of the wonders of this region, which they would otherwise have seen. In their constant passing to and fro in different directions through the forest, along the lakes, and over the surrounding mountains, they had gleams of objects which, had they been free from a heavy charge, it would have been pleasant to visit and describe. These, however, are reserved for future investigation. The plan of their route led them in a northwesterly direction from the lake, towards the head-waters of the Madison River. They traveled through a dense pine forest, unmarked

by trails, and encumbered by fallen timber, for most of the distance. The close of the first day's travel found them only twelve miles from the lake, still in the midst of the deep snow, with no place to pitch their tent, and each man seeking, unsuccessfully, a dry spot whereon to spread his blankets, under the shelter of the trees. The next day they reached the east bank of the Fire Hole River, the largest tributary of the Madison River, down which they traveled, passing several cascades, many craters and boiling springs, to a large basin, two miles above the point of the union of the Fire Hole and Burnt Hole Rivers.

They bade adieu to Yellowstone Lake, surfeited with the wonders they had seen, and in the belief that the interesting portion of their journey was over. The desire for home had superseded all thought of further exploration. They had seen the greatest wonders on the continent, and were convinced that there was not on the globe another region where, within the same limits, nature had crowded so much of grandeur and majesty, with so much of novelty and wonder. Their only care was to

return home as rapidly as possible. Three days of active travel from the head waters of the Madison, would find them among the settlers in the beautiful lower valley of that picturesque river, and within twelve miles of Virginia City, where they hoped to meet with Mr. Evarts, and realize afresh that all is well that ends well.

Judge, then, what must have been their astonishment, as they entered the basin at mid-afternoon of their second day's travel, to see in the clear sunlight, at no great distance, an immense volume of clear, sparkling water projected into the air, to the height of one hundred and twenty-five feet. Geysers! Geysers! exclaimed one of their company, and, spurring their jaded horses, they soon gathered around this wonderful phenomenon. It was, indeed, a perfect geyser. The aperture through which the jet was projected was an irregular oval, three feet by seven in diameter. The margin of sinter was filled with little hollows full of water, in which were small globules of sediment, some having gathered around bits of wood and other nuclei. This geyser is elevated thirty feet above the level



THE FAN GEYSER.

of the surrounding plain, and the crater rises five or six feet above the mound. It spouted at regular intervals nine times during their stay, the columns of boiling water being thrown from ninety to one hundred and twenty-five feet at each discharge, which lasted from fifteen to twenty minutes. They gave it the name of Old Faithful. In their journey down the valley, looking down through a crevice in the crust upon which they were traveling, they discovered a stream of hot water, of considerable size, running nearly at right angles with and away from the Fire Hole River.

On the summit of a cone, twenty feet high, was a boiling spring, seven feet in diameter, surrounded with beautiful incrustations, on the slope of which they gathered twigs and pine tree cones, encased in a silicious crust a quarter of an inch in thickness. But all of the curiosities of this basin sink into insignificance in comparison with the geysers. They saw, during their brief stay of but twenty-two hours, twelve in action. Six of these, from vents varying from three to five feet in diameter, throw water to the height of from

fifteen to twenty-five feet, but in the presence of others of immense dimensions these soon ceased to attract attention. One, which they named the Fan, has an orifice which discharges two radiating jets of water to the height of sixty feet, the falling drops and spray resembling a feather fan. It is very beautiful. Its eruptions are very frequent, lasting usually from ten to thirty minutes. A vent connected with it, about forty feet distant, expels dense masses of vapor fifty or sixty feet high, accompanied by loud, sharp reports during the time the geyser is in action. The Grotto was so named from its singular crater of vitrified sinter, full of large, sinuous apertures. Through one of these, on their first visit, one of their company crawled to the discharging orifice; and when, a few hours afterwards, he saw a volume of boiling water, four feet in diameter, shooting through it to the height of sixty feet, and a scalding stream of two hundred inches flowing from the aperture he had entered a short time before, he concluded he had narrowly escaped being summarily cooked. The discharge of this geyser continued for nearly half an hour. The Castle, situated on

THE GROTTO GEYSER.

the summit of an incrusted mound, has a turreted crater, through which a large volume of water is expelled, at intervals of two or three hours, to the height of fifty feet, from a discharging orifice about three feet in diameter. The architectural features of the silicious sinter surrounding it, which is very massive and compact, indicating that at some former period the flow of water must have been much greater than at present, suggested its name. A vent near it is constantly discharging a large stream of boiling water, and when the geyser is in action the water in this vent boils and bubbles with great fierceness. The Giant has a rugged crater, ten feet in diameter on the outside, with an irregular orifice five or six feet in diameter. It discharges a vast body of water, and the only time they saw it in eruption the flow of water in a column five feet in diameter and one hundred and forty feet in vertical height continued uninterruptedly for nearly three hours. The crater resembles a miniature model of the Coliseum.

Their search for wonders leading them across the Fire Hole River, they ascended a gentle incrusted slope, and came suddenly

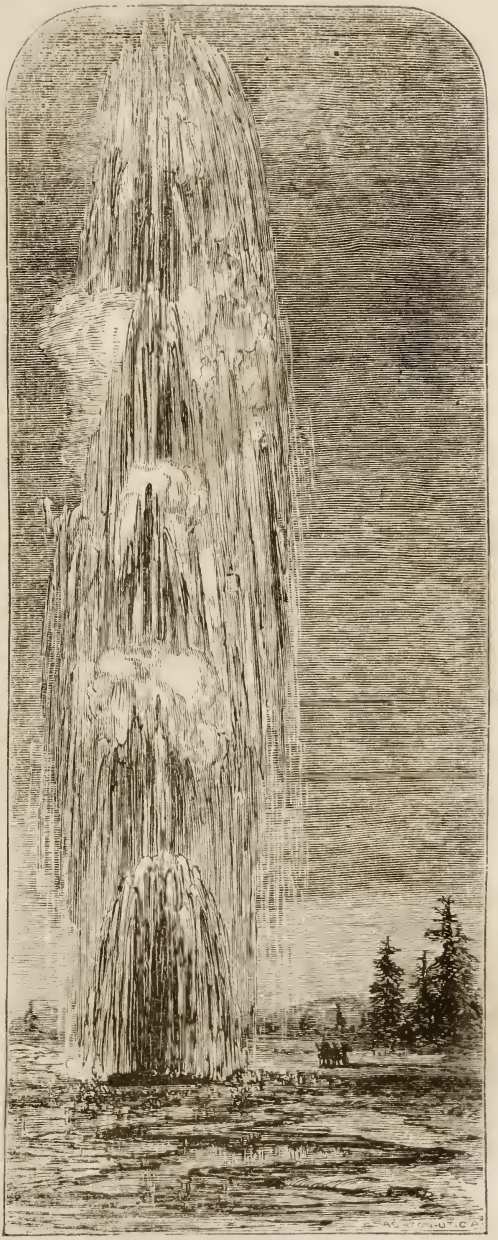
upon a large oval aperture, with scolloped edges, the diameter of which was eighteen and twenty-five feet, the sides corrugated and covered with a grayish-white silicious deposit, which was distinctly visible at the depth of one hundred feet below the surface. No water could be discovered, but they could distinctly hear it gurgling and boiling at a great distance below. Suddenly it began to rise, boiling and spluttering, and sending out huge masses of steam, causing a general stampede of our company, driving them some distance from their point of observation. When within about forty feet of the surface it became stationray, and they returned to look down upon it. It was foaming and surging at a terrible rate, occasionally emitting small jets of hot water nearly to the mouth of the orifice. All at once it seemed seized with a fearful spasm, and rose with incredible rapidity, hardly affording them time to flee to a safe distance, when it burst from the orifice with terrific momentum, rising in a column the full size of this immense aperture to the height of sixty feet; and through and out of the apex of this aqueous mass, five or six lesser

jets, or round columns of water, varying in size from six to fifteen inches in diameter, were projected to the marvelous height of two hundred and fifty feet. These lesser jets, so much higher than the main column, and shooting through it, doubtless proceed from auxiliary pipes leading into the principal orifice, near the bottom, where the explosive force is greater. If the theory that water by constant boiling becomes explosive when freed from air, be true, this theory rationally accounts for all irregularities in the eruptions of the geysers.

This grand eruption continued for twenty minutes, and was the most magnificent sight they had ever witnessed. They were standing on the side of the geyser nearest the sun, the gleams of which filled the sparkling column of water and spray with myriads of rainbows, whose arches were constantly changing—dipping and fluttering hither and thither, and disappearing only to be succeeded by others again and again amid the aqueous column, while the minute globules into which the spent jets were diffused when falling, sparkled like a shower of diamonds, and

around every shadow which the dense clouds of vapor, interrupting the sun's rays cast upon the columns, could be seen a luminous circle radiant with all the colors of the prism, and resembling the halo of glory represented in paintings as encircling the head of Divinity. All they had previously witnessed seemed tame in comparison with the perfect grandeur and beauty of this display. Two of these eruptions occurred during the twenty-two hours they remained in the valley. This geyserthey named the Giantess.

A hundred yards distant from the Giantess was a silicious cone, very symmetrical, but slightly corrugated upon its exterior surface, three feet in height and five feet in diameter at its base, and having an oval orifice twenty-four by thirty-six and one-half inches in diameter, with scolloped edges. Not one of their company supposed it was a geyser; and among so many wonders it had almost escaped notice. While they were at breakfast on the morning of their departure, a column of water entirely filling the crater shot from it, which by accurate triangular measurement, they found to be two hundred and nineteen feet in



THE GIANTESS GEYSER.

height. The stream did not deflect more than four or five degrees from a vertical line, and the eruption lasted eighteen minutes. They named it the Bee Hive.

How many more geysers there are in this locality it would be impossible to conjecture. Their waning stores admonished them of the necessity for a hurried departure, and they reluctantly left this remarkable region less than half explored. In this basin, which is about two miles in length and one mile in width, more than a thousand pipes or wells rise to the surface, varying in diameter from two to one hundred and twenty feet, the water in which varies in temperature from 140 degrees to the boiling point, upwards of a hundred of which give evidence, by the calcareous and silicious deposits surrounding them, that they are as likely to be as any they saw in action.

The sides of these wells were covered with silicious incrustations, and were funnel-shaped; and in many of the larger ones gradually converged for a distance of from twenty to fifty feet from the edge, below which point the apertures enlarged laterally in all direc-

tions like a jug below the neck, and were apparently unfathomable. None of the springs in this locality appear to be impregnated with sulphur. In this basin there are to be found no mud springs, of which they discovered so many in the valley of the Yellowstone; and they found but one spring of cold water. This entire country is seemingly under a constant and active internal pressure from volcanic forces, which seek relief through the numberless springs, volcanos and geysers exhibited on its surface, and which, but for these vents, might burst forth in one terrific eruption and form a volcano of vast dimensions. It is undoubtedly true that many of the objects they saw were of recent formation, and that many of the extinguished craters recently ceased their condition of activity. They are constantly breaking forth, often assuming new forms, and attesting to the active presence of volcanic force.

A mountaineer who visited a portion of this region a year ago, found at one place a small volcano which was constantly overflowing with liquid sulphur and lava, and emitting smoke, showing that the genuine

volcanic elements were there, and needed but the concentration of the forces now dissipated through thousands of vents, to present a spectacle of grandeur surpassing that of Vesuvius or Ætna.

The geyser is a new, and perhaps the most remarkable feature in our scenery and physical history. It is found in no other countries but Iceland and Thibet. The geysers of the country last named are inconsiderable when compared with those of Iceland, or the Fire Hole, or Madison Basin; and those of Iceland, even, dwindle into insignificance by the side of those of the Madison River. Until the discovery of the Madison geysers, there were but two of any note known to the world—the Great Geyser and Stroker of Iceland. The phenomena presented by these have been sufficient at various periods during the past century to invite the personal investigation of some of the most distinguished of European geologists. Von Troil, Stanley, Ohlsen, Hooker, McKenzie, and at a later day, Bunsen, have visited Iceland for the purpose of witnessing these aqueous eruptions, and forming some satisfactory conclusion relative to the causes in which they originated.

The theory published by Sir George McKenzie, that the outbursts were produced by pressure on the air contained in cavernous recesses, under ground, for many years received the sanction of the scientific world. The periods intervening between the eruptions of the Great Geyser of Iceland have been very irregular until within the past forty or fifty years, since when it has generally projected a small jet to the height of twenty feet every two hours, and a large one to the height of eighty feet every six hours. McKenzie's theory was that there were two subterranean cavities connected with the main pipe, one much deeper and larger than the other, which rapidly filled with water after each eruption, and that the pressure of the vapors upon them produced these periodic explosions. Ingenious as this theory appeared to be, it was dissipated by the experiments made upon water by M. Donny, of Ghent. He discovered that water long boiled became more and more free from air, by which its molecular cohesion is so greatly increased, and that, when it is exposed to a heat sufficient to overcome the force of cohesion, the production of steam is so instan-

taneous and so considerable as to cause explosion. Bunsen ascribes the eruption of the geysers to this cause. He found the water at the bottom of the well of the Great Geyser of Iceland to be of a constantly increasing temperature up to the moment of an eruption. On one occasion it was as high as 261 degrees Fahrenheit. His idea is that on reaching some unknown point above that temperature, ebullition takes place, vapor is suddenly generated in enormous quantities, and eruption of the superior column of the Madison geysers, we have abundant proof in the vast incrusted field by which they are surrounded. They are but a reproduction, upon a much grander scale of the phenomena of Iceland.

A wider field for the investigation of the chemist than that presented by the geysers, may be found in the many tinted springs of boiling mud and the mud volcano. These were objects of the greatest interest to Humboldt, who devotes to a description of them one of the most fascinating chapters of Cosmos. It would be rash in us to speculate where the great man hesitated. We can only say that the field is open for exploration,

illimitable in resource, grand in extent, wonderful in variety, in a climate favored of Heaven, and amid scenery the most stupendous on the continent.

By means of the Northern Pacific Railroad, which will doubtless be completed within the next three years, the traveler will be able to make the trip to Bosman City, in Montana, from the Atlantic seaboard in three days, and thousands of tourists will be attracted to both Montana and Wyoming, in order to behold with their own eyes the wonders here described.

Besides these marvels of the Upper Yellowstone, one may look upon the strange scenery of the lower valley of that great river, the Great Falls of the Missouri River, the grotesque groups of eroded rocks below Fort Benton, the beautiful canyon of the Prickly Pear, and the stupendous architecture of the vast chains and spurs of mountains which everywhere traverse that picturesque and beautiful country.

A topographical party, sent by Government in 1872, had Fort Hall, Idaho, as their base of operations. From thence they pro-

ceeded up Henry's Fork to Snake River, and encamped nine days at the Three Tetons. This period was spent in exploring this range correctly, and taking the topography. A portion of this party, fourteen in number, attempted to ascend the highest of these Tetons; Captain Stevenson and Mr. Langford alone succeeded in reaching the summit. Their barometer showed an altitude of 13,400 feet.

The party then passed on to Henry's Lake, and it was there that a most important topographical discovery was made. Four easy and practicable passes were found through the mountain, and Henry Lake is situated in the center of them. They offer no obstacle to travel, but connect by an easy grade the great basin and the Pacific slope with the great Northwest. The maximum grade from Fort Hall to the source of the Madison by the way of Henry's Fork, is not more than twenty feet to the mile. This route will open to settlement and connect with the Union Pacific, one of the most productive and interesting portions of the West. More than 2,500 square miles of pine timber, and a vast area of

pastural and arable land will thus be made accessible.

The Targee Pass, 6,500 feet elevation, smooth as a lawn, connects the marvelous district about the sources of the Madison and Yellowstone. The Madison Pass has 6,300 feet elevation, leads to the Lower Madison and connects with the fertile valley of the Three Forks. The Red Rock Pass, 6,300 feet elevation, opens the great Jefferson Valley, and Henry's Pass leads to the Teton Basin and Fort Hall. These mountain passes are often so low and smooth that they may be traversed by wagon roads or railroads with ease. Travelers watch the flow of the streams in order to tell when they are crossing from one water shed to another.

EXTRACTS FROM SCRIBNER'S MONTHLY.

Another party of explorers made a visit to the Yellowstone River and lake in July, 1872. On arriving at Boteler's Ranch they pitched their tent close to the lower canyon of the Yellowstone. At this point they changed their mode of travel from wagons to pack horses. Here began the more difficult part of

their journey. The whole party were filled with enthusiasm to catch a glimpse of the wonders of the Yellowstone.

Opposite their camp were the Yellowstone mountains, with peaks rising 12,000 feet above the sea level, and 6,000 feet above the valley. For beauty and symmetry of outline, it is splendid and interesting to behold, and several members of the party who were familiar with the mountains of Central Europe, were struck at once with the resemblance to the Alps. Continuing their way up the valley, leaving the lofty volcanic hills which walled them in on either side, they entered the lower canyon. Here granite walls rise on either side to the height of a thousand feet or more, and through the narrow gorge the river dashes with great velocity. The bright green color of the water, and the numerous ripples capped with white foam, as the roaring torrent rushes around and over the multitude of rocks that have fallen from above into the channel, give a most picturesque view to the eye as they looked from their lofty heights. Not the least attractive feature, and one that to them amounted to wonder, was the abundance of

fine trout which the river afforded. There seemed to be no limit to them, and hundreds of pounds weight of the speckled beauties were caught by the different members of their party. The scenery here is very attractive.

Arriving at the Devil's Slide, or Cinnabar Mountain, as it is usually called, which is one of the singular freaks of nature that occur very seldom in the West, they found it composed of alternate beds of sandstone, limestone and quartz; it is elevated to a nearly vertical position by those internal forces which acted in ages past to lift the mountain ranges into their present height. As they stood at the base and looked up the sides of the mountains, they were filled with wonder at the apparent evidences of the convulsions of nature which could have thrown 3,000 to 5,000 feet in thickness of rocks into their present position. Ridge after ridge extends down the steep sides of the mountain like lofty walls, the intervening softer portions having been washed away, leaving the harder layers projecting far above. At one locality the rocks incline in every possible direction, and are crushed together in the utmost confusion.

Between the walls at one point is a band of bright brick red clay, which has been mistaken for cinnabar, and hence the name of the mountain. The most conspicuous ridges composed of basalt, and the igneous material was poured out on the surface when all the rocks were in a horizontal position during the Jurassic period. Indeed, all the rocks are either of the Carboniferous, Jurassic, or Cretaceous age. During the day they passed many examples of volcanic action, which in any other region would have excited attention. Small lakes, covered with wild fowl and fringed with a luxuriant growth of vegetation, occupied the old volcanic craters. On the evening of the third day, as they came to the junction of Gardiner's River, the warm springs began to appear near the edge of the stream. The white calcareous deposit which always indicate that those springs do exist, or have existed, covered the bottom, and from underneath this crust a stream poured a volume of water into the river, six feet wide and two feet deep, with a temperature of 130 degrees. A little further up the stream were a number of hot springs of the same temperature, with nearly

circular basins six to ten feet in diameter and two to ten feet deep. Around them had already gathered a number of invalids, who were living in tents, and their praises were enthusiastic in favor of the sanitary effects of the springs. Some of them were used for drinking, and others for bathing purposes. From the river their path led up the steep sides of the hill for about one mile, when they came suddenly and unexpectedly in full view of the springs. This wonder alone, the whole company agreed, surpassed all the descriptions which had been given by former travelers. Indeed, the Langford party saw nothing of this. Before them arose a high white mountain looking precisely like a frozen cascade. It is formed by the calcareous sediment of the hot springs, precipitated from the water as it flows down the steep declivities of the mountain side. The upper portion is about one thousand feet above the waters of Gardner's River. The surface covered with the deposit comprises from three to four square miles. The springs now in active operation cover an area of about one square mile, while the rest of the territory is occupied by the

remains of springs that have long ceased to flow. They pitched their camp upon a grassy terrace at the base of the principal group of active springs. Just in the rear of them were a series of reservoirs or bathing pools, rising one above the other, semi-circular in form, with most elegantly scolloped margins composed of calcareous matter, the sediment precipitated from the water of the spring. The hill, which is about two hundred feet high, presents the appearance of water congealed by frost as it quickly flows down a rocky declivity. The deposit is as white as snow, except when tinged here and there with iron or sulphur. Small streams flow down the sides of the snowy mountain, in channels lined with oxide of iron, colored with the most delicate tints of red. Others present the most exquisite shades of yellow, from a deep bright sulphur to a dainty cream-color. In the springs and in the little channels is a material like the finest Cashmere wool, with its slender fibres floating in the water, vibrating with the movement of the current, and tinged with various shades of red and yellow as bright as those of our ani line dyes. These delicate wool-like masses are

undoubtedly plants, which seem to be abundant in all the hot springs of the West, and are familiar to the microscopist as diatoms. Upon a kind of terrace covering an area of two hundred yards in length and fifteen in width, are several large springs in a constant state of agitation, but with a somewhat lower temperature than the boiling point. The hottest is 162 degrees; others are 142 degrees, 155 degrees, and 156 degrees, respectively. Some of them give off the odor of sulphuretted hydrogen quite perceptibly. A qualitative analysis shows the water to contain sulphuretted hydrogen, lime, soda, alumina, and a small amount of magnesia. It is beautifully clear and slightly alkaline to the taste. The water, after rising from the spring basins, flows down the sides of the declivity, step by step, from one reservoir to the other, at each one of them losing a portion of its heat, until it becomes as cool as spring water. Within five hundred feet of its source the party camped for two days by the side of the little stream formed by the aggregated waters of these hot springs, and found the water most excellent for drinking as well as for cooking

purposes. It was perfectly clear and tasteless, and harmless in its effects. During their stay here all the members of the party, as well as the soldiers comprising their escort, enjoyed the luxury of bathing in these most elegantly carved natural bathing pools; and it was easy to select, from the hundreds of reservoirs, water of every variety of temperature. These natural basins vary in size, but many of them are about four by six feet in diameter, and one to four feet in depth. With a foresight worthy of commendation, two men have already pre-empted 320 acres of land covering most of the surface occupied by the active springs, with the expectation that, upon the completion of the Northern Pacific Railroad, this will become a famous place of resort for invalids and pleasure-seekers. Indeed, no future tourist in traveling over the far West will think of neglecting this most wonderful of the physical phenomena of that most wonderful and interesting region. The level or terrace upon which the principal active springs are located, is about midway up the sides of the mountain, covered with the sediment. Still farther up are the old ruins of

what must have been at some period of the past, even more active springs than any at present known.

The sides of the mountain for two or three hundred feet in height are covered with a thick crust of the calcareous deposit, which was originally ornamented with the most elegant sculpturing all over the surface, like the bathing pools below. But atmospheric agencies, which act readily on the lime, have obliterated all their delicate beauty. Chimneys partially broken down are scattered about here and there with apertures varying in size from two inches to two feet in diameter. Long rounded ridges are also quite numerous, with fissures extending the entire length, from which the boiling water issued forth and flowed over the sides. Thus the sediment was continually precipitated in their oval layers, so that a section of these oblong chimneys presents the appearance of layers of hay in a stack, or the thatched cabin of a peasant. Some of these chimneys were undoubtedly formed by geysers, now extinct; others by what may be called spouting springs, as those which are in a constant state of violent ebulli-

tion, throwing the water up two to four feet, a phenomenon intermediate between a boiling spring and a true geyser. The water is forced up through an orifice in the earth by hydrostatic pressure, and overflowing, precipitates the sediment around it, and thus, in time, it builds up a mound varying in height according to the force of the pressure. One of these cones is very remarkable, surpassing any observed in any other portion of the West. From its peculiar form they almost involuntarily named it the Liberty Cap. It is entirely composed of carbonate of lime, in flexible cap-like layers, with a diameter at the base of fifteen feet, and a height of about forty feet. It is completely closed over at the summit. This is probably an extinct geyser, and was the most powerful of the group. Sometimes the orifice is in the form of a fissure 100 to 300 feet in length, and the mound built up by the deposition of the sediment will be of oblong shape. As the mound rises, the hydrostatic force diminishes, until finally the spring entirely conceals itself at the summit, and either becomes extinct or flows out through fissures in the sides. Classed with reference

to their chemical constituents, there are two kinds of springs in the Valley of the Yellowstone, viz: those in which lime predominates and those in which silica is most abundant. In respect to beauty of form, the calcareous springs build up monuments that far surpass the others.

The stalactites and beautiful fresco-work in the Mammoth Cave in Kentucky are precipitated from springs holding a great amount of lime in solution. The remarkable forms which lime is caused to assume through the influence of water is well shown in all limestone regions. The scenery in the vicinity of these hot springs is varied and beautiful beyond description. I have already stated that they are located 1,000 feet above the channel of the Yellowstone, and thus commands a very extended view up and down the valley. To the north, the Devil's Slide can be distinctly seen, while on either side the mountains rise to the height of 2,000 feet, inclosing the valley as with gigantic walls. From the summit still higher, piercing the clouds, are numerous basaltic peaks, presenting a great variety of unique forms.

To the eastward is a bluff wall composed of 1,200 to 1,500 feet of strata, revealing one of the most perfect geological sections observed in the West. On the summit is a thick cap of basalt which extends up Gardner's River, and forms the floor over which the waters of the east, middle and west forks of that stream flow, and dash down in most beautiful cascades. In the sides of the canyons of these branches are rows of basaltic columns as perfect as those so familiar to all who have visited Fingal's Cave in Staffa. In all explorations in the far West nothing of the kind has been found to equal this wonderful exhibition, like this semi-crystallized structure. Between the middle and west forks stands the dome-like form of Mount Evarts, clothed with a dense growth of pines, its summit covered with fragments of basalt. From its top the view is grand, reaching over a radius of fifty to one hundred miles in every direction. On the west are the higher ranges of mountains about the sources of the Gallatin and Missouri, with their loftiest peaks covered with perpetual snow. Here is the most extended and beautiful view of the valley.

Near Tower Falls the Grand Canyon of the Yellowstone River commences, and continues about thirty miles to the Great Falls. In some respects this canyon is the greatest wonder of all. The river has carved out a channel through the basalt volcanic freccia and hot spring deposits, one thousand to twelve hundred feet deep, and one to two thousand feet in width, at the bottom of which the water foams along with torrent-like rapidity. But the striking feature of this remarkable view is the effect of colors derived from the hot spring deposits, which have a brilliancy like the most delicate of our aniline dyes, which art cannot equal. Between the upper and lower falls a fine stream, called Cascade Creek, empties into the Yellowstone. Standing upon the east margin of the canyon one can look up the channel of this little creek a few hundred feet and enjoy a full view of Cascade Falls, which have given the name to the creek. The water, as it pours over a succession of basaltic steps, separates into a number of little streams, giving to the whole view a most pleasing effect. Above the falls the river seems to flow quietly along over

the surface, but little below the general level, and here it may be said to present some of its finest and most attractive views. While below the falls this river surpasses all others in the West for its rugged grandeur, above the falls it excels in picturesque beauty. About half a mile above the falls the gorge is so narrow and deep that the traveler looks down from the margin above into an abyss so dark and forbidding, that a very appropriate name comes almost involuntarily to one's lips, the Devil's Den. The sides of the gorge are very rugged, composed of angular masses of basalt and obsidian cemented with volcanic ashes. There is also a large amount of sulphur mingled with the ashes, so that the debris looks like the remains of an old furnace. On either side of the river, as they ascended the valley, are remarkable groups of hot springs. There is a singular group on the south side of Mount Washburn, which is well worthy the attention of the traveler. The deposit formed by these springs extends across the Yellowstone River and occupies a large area. Most of these springs contain clear water, but there are several which are called mud springs. These

mud springs do not differ in their origin from the others. Some are what may be called dead springs, as those which have passed the period of their activity, and are now filled with turbid water. Others are in a constant state of agitation, and may be called living springs, while others at certain periods throw out great quantities of mud, and may be called mud geysers. There is every grade, from simply turbid water to thick mud.

The superficial deposits here are composed of basalt and hot spring deposits, as silica and feldspar. And as the aperture through which the hot water reaches the surface sometimes extends a considerable distance through this material, it is dissolved from the sides of the passage, and mingling with the boiling water becomes in due time much like boiling mush. Whenever the mud becomes so thick as to close up the orifice for any length of time, a sort of explosion takes place, which sometimes hurls masses of the mud to the height of fifty or one hundred feet.

At Mud Springs and Crater Mountains there are several of these mud springs, with basins varying in size from a few inches to

thirty feet in diameter, mostly with circular rims and funnel-shaped orifices. The most interesting of the mud springs occur in the valley of the Fire-Hole Creek; some of them are filled with black mud, others a brownish clay; but in a few instances the mud has the snowy whiteness, which is due to the decomposition of the silica deposited from the hot waters. To heighten the effect, it is also tinged with the bright red from the oxide of iron. Some of these may be called alum springs, from the fact that the mud is composed largely of alum. Sometimes there will be a group of fifteen or twenty of these little mud springs, with orifices from two to six inches in diameter, all of them operating at the same time with a low thud-like noise. They made their first camp on the north-east shore of the lake, near the point where the river takes its departure from the lake. Here they had one of the finest views of this beautiful sheet of water. This portion of the lake is about ten miles wide. Their company was located in a broad, open, meadow-like space, with the grass two feet or more in height, adorned with bright flowers, having a great variety of colors. A

dense growth of pine surrounded it, and to the eastward the range of forest-covered hills was 1,200 to 1,800 feet above the lake. At this place they launched their little boat, which which was destined to perform most excellent service. They had transported the framework on the back of a mule from Fort Ellis. They covered the frame with a heavy canvas, which rendered it perfectly water-tight, and with this little craft, twelve feet long, three and a half feet wide, and twenty-two inches high, the entire length and breadth of the lake was navigated many times. Soundings of the lake were made in every direction, and the greatest depth discovered was three hundred feet. Messrs. Elliot and Carrington made a survey of the shore line from the boat and with the numerous bays and indentations they estimated the distance to be about one hundred and seventy-five miles. So far as beauty of scenery is concerned, it is probable that this lake is not surpassed by any other on the globe. While some were making an exploration of this beautiful lake, the writer, with a small party, made a trip over the high mountain between the waters of the Yellow-

stone and Missouri Rivers into the Fire-Hole Basin.

They had already encountered many of the difficulties attendant upon traveling in this rocky and densely wooded region, but they were not prepared for the impediments which seemed to block their pathway everywhere. They were without a guide and endeavored to make their courses with a compass. After encountering many obstructions they arrived at the Fire-Hole Basin, and spent five days in exploring its wonders, making charts, photographs, and taking the temperature of the springs. The boiling point of water at this point is about 192 degrees to 196. degrees. They ascertained the temperature of more than six hundred hot springs in this valley, and there were as many more that were dying out, to which they did not think it worth while to give their attention. Many, also, must have been overlooked by them; so that within an area of about five miles square they estimated the existence of about 1,200 to 1,500 springs, with basins of all sizes, from a few inches in diameter to three hundred feet. The springs in this valley are of three kinds,

but varying much in their active power: 1st, those in which the ebullition occurs only at intervals, and which may therefore be called intermittent springs; 2d, such as are constantly boiling and bubbling up, therefore permanent springs; 3d, those whose surface is always undisturbed, and in which there is no bubbling or boiling up. The first class reach the boiling point only when in operation; when in a state of repose the temperature of the water is as low as 150 degrees. The second class have a temperature equal to boiling water, or not far below it—in this region, varying from 180 degrees to 196 degrees. Some of the largest of the springs are in a constant state of agitation. The basin is about two hundred feet in diameter, and the sides of the crater, which have been much broken down, are about thirty feet deep. The crater is so filled with dense steam that it is only at periodical times that it is cleared away so that one can catch a glimpse of the seething caldron below. From one side of it five streams of water are ever flowing, which in the aggregate form a river ten feet wide and two feet deep. The delicate shades of coloring from the iron and

sulphur are most finely displayed upon the surface over which this water flows.

But perhaps the most striking exhibition of Nature's forces in this wonderful region is that of the Grand Geyser. While they were in the Fire-Hole valley this geyser played only at intervals of about thirty-two hours; but when it was in active operation the display was grand beyond description. As they stood near the crater or basin, it threw up, with scarcely any preliminary warning, a column of hot water eight feet in diameter to the height of two hundred feet; and so steady and uniform did the force act, that the column of water appeared to be held there for some minutes, returning into the basin in millions of prismatic drops. This was continued for about fifteen minutes, and the rumbling and confusion attending it could only be compared to that of a charge in battle. The steam poured out in immense masses, rising in clouds a thousand feet or more in height. After the Grand Geyser had ceased playing, the water of the basin retired from the surface, and the temperature fell gradually to 150 degrees. Another geyser in the same group,

and named by the Langford party Old Faithful, was far more accommodating, and played at intervals of only an hour, throwing up a column of water at least six feet in diameter and one hundred and fifty feet high, for a period of about fifteen minutes. The ease with which this column of water was sustained at the great height during the period of its operation rendered it a marvel of beauty as well as of power. It is quite impossible for any one to do justice to the remarkable physical phenomena of the valley by any description, however vivid. It is only through the eye that the mind can form anything like an adequate conception of their beauty and grandeur.

FALLS OF NIAGARA.

These falls are situated in the Niagara River, which is the boundary line between the United States and Canada. This river, where it issues from Lake Erie, is about twenty-five feet deep and three-quarters of a mile in width. The length of the river from Lake Erie to Lake Ontario is about thirty-seven miles, its average descent is fifty feet in half a mile; the falls are twenty-two miles below Lake Erie or Buffalo; Goat Island, at the verge of the cataract, divides the water in two parts, but they unite again long before they reach the bottom. That portion of the river on the American side is 1,072 feet wide, and the curvature of the great Horseshoe Fall on the Canada side is 2,376 feet wide, making the whole width at the falls 3,448 feet. The perpendicular fall at the cataract is 150 feet. In a still time, and wind right, the roar of the cataract can be heard at Buffalo, a distance of twenty-two miles. Considering the large volume of water,

they are said to be the largest and most powerful falls known to the world.

There is no doubt but the Falls of Niagara at some remote period were at Queenstown, which is about seven miles below their present situation. The breadth of the gorge or excavation made by the waters is, on approaching the falls, about 1,200 feet, but it is much narrower towards Queenstown. The kind of rock through which it passes consists of limestone and shale, the latter a dark colored shelly formation, eighty feet thick, lying under the limestone. The limestone is seventy feet thick, above which is the ordinary soil of the country. The limestone is hard, and lies in horizontal strata at the edge of the falls; but the shale is soft, and is acted upon with much greater facility than the limestone, so that the latter rock often overhangs the former perhaps forty feet at the edge of the precipice. The blasts of wind, charged with spray, which rise out of the pool into which this enormous cascade is projected, strike against the shale beds so that their disintegration is constant; and the superincumbent projecting limestone being left without a foundation, falls from time to

time in immense rocky masses. When these enormous fragments fall a shock is felt often at considerable distance, accompanied by a noise resembling a distant clap of thunder.

The waters which expand at the falls where they are divided by the Island, are contracted again after their union into a stream averaging not more than 500 feet broad. In the narrow channel, immediately below this immense rush of waters, a boat may pass across the stream with safety. The pool into which the cataract is precipitated being 170 feet deep, the descending water sinks down and forms an under current, while a superficial eddy carries the upper stratum of water back towards the main fall.

CANYON OF THE COLORADO RIVER.

In the region south of Salt Lake, the immense ravine or canyon of the Colorado, which in some places is a gorge six thousand feet deep, has been gradually worn through the rock by agencies probably similar. Both this and the many other vast rocky cleffs there have been attributed to volcanic action, or the effect of earthquakes; but the later and better opinion seems to be that they are due solely to the scouring of the river beds during many successive ages, by the stones and gravel borne down in the water.

Moss agates, popularly supposed to contain specimens of real moss, but which are simply silicious formations penetrated with iron solutions taking the form of mosses, vines, trees, &c., are found along the Union Pacific road at points for 200 miles from Cheyenne westward. The blue and cream agates are the most highly prized.

A TRIP UP THE PENOBSCOT RIVER.

The Penobscot River in the state of Maine is one of the most wild, romantic and delightful rivers in the eastern part of our country. From Oldtown to Bangor the river presents one continuous fall from rock to rock, full of changes, interesting and splendid beauty. The rough variety, bluffs, hills and mountains richly compensate one for a trip up the river. From the head of tide-water, at the city of Bangor, to the mouth of the river, a distance of about thirty miles, it was known to the Indians by the name of Baam-tu-guai, which means broad river, sheet of water, or more literally, all waters united. Another section of the river is called Gim-sit-i-cook, signyfying smooth or dead water. This river, on many accounts, is the most important one in Maine, and at present, from its vast lumbering resources and operations, the most noted. It is three hundred and fifty miles long, with numerous, and, in some instances, copious branches which drain

an immense uncultivated territory, embracing a region of country from east to west about one hundred and fifty miles in breadth. Spanning the whole of the northern portion of the State, running round and cutting off the head waters of the St. Croix on the east, and of the Kennebec on the west, interlacing its numerous branches with those of the St. John's River in the north, which brings within its embrace about one-third the entire wilderness territory of Maine.

The scenery in some sections of this territory about the head waters, is grand and beautifully picturesque. Its numerous waterfalls, some of which are grand and fearful to contemplate, are hazardous for the driver of logs to work them over the falls. Its swelling hills, and in some instances towering mountains, from whose tops may be counted an almost endless number of lakes, and the vast groves of towering pines here and there scattered over millions of acres of forest land, make it altogether one of the wildest and most romantic portions of the country.

One of the most attractive features in the interior is Mount Katahdin, which, from its

isolated position, height, and sublime grandeur as the birth-place of storms, surrounded with a beautiful, rich and luxuriant forest, with streams and lakes, is worthy of special attention. To stand upon the top of Mount Katahdin, far above the forest trees on the plain below, there to see the soft green foliage of the trees waving in the breeze, interspersed with lakes, seemingly as though they lay basking in the midst of the tops of the trees, there to count about thirty lakes at one view, all surrounded by the waving foliage of the forest, and the sunbeams glittering upon the surface of the clear blue waters of the lakes, sparkling like a bed of diamonds set in the soft green foliage of the trees, give a grand, picturesque and enchanting scenery unequalled by art.

The following sketch of a visit to this mountain by a party of gentlemen may be esteemed worthy of a perusal: Our travelers, after having made the ascent of the river to the proper point, and made the necessary arrangements for their journey up the mountain, entered the slide at eight o'clock A. M., in the early part of September, and found its

ascent quite steep, though not difficult or dangerous when one takes time.

On almost all sides of the mountain there is a short, tangled growth of alders and white birch coming up between the rocks. These, being kept down by the winds, grow into an almost impassable bramble. At a distance it has a beautiful, smooth appearance, like a green, grassy hill, or what one of the company called a field of oats. The slide serves as a path up through all this tangle, reaching to the top of the south-eastern ridge of the mountain, which is above all timber growth, making about one-third of the whole perpendicular height of Katahdin, to which the ascent of the brook below would add another third. Although it was hard climbing, we ascended pretty fast, and the clear morning air gave an indescribable beauty to the prospect below. The most pleasing was the constant change and variety caused by our rapid ascent. It was known that the mountain at this season of the year is frequented by bears in pursuit of cranberries, but we did not see any, though our gunner had enjoined silence in hopes of obtaining a shot. I remained in the rear to see

all up safe. The most zealous went ahead, and were soon out of sight, until near the head of the slide we heard them from the distant topmost peaks, calling out, come on, ye braves! At this distance they looked very small in stature. From the head of the slide we turned to the left and ascended north-west to the first and eastern peak; by this time our comrades had reached the most western. We here paused to view our position. It is, perhaps, the most favorable spot to view the whole structure. From thence the principal peaks are in a curved line, going south-west, then west and north-west.

The second peak, called by us the Chimney, is near the first, but separated by a sharp cut one hundred and fifty or two hundred feet deep, and nearly square in its form. We had seen one of our comrades upon its summit, else we might not have attempted the ascent. His zeal seemed to blind him to danger, for, when questioned on our return, he could not tell when or how he ascended. Our first plan was to pass around the base without going over the top; but this we found impossible, and were about to give up when one pointed

out a diagonal course, where, by taking a few long steps, he thought we could ascend. I tried first and succeeded, and all followed but two. From the Chimney we went from one hammock to another, making on the whole a gradual ascent till we reached the middle of the principal peaks, a distance of nearly half a mile. There we met our comrades on their return from the western peak, and all sat down to rest. Here we found a monument that had been erected by some former visitor, but was overgrown with moss, appearing lonely, as if it had seen no relations for years. On the first and most eastern peak, all the monuments which I had made the year previous looked new and fresh. It is not easy to decide which of the two (the western and middle peak) is the highest. Judgment was given in favor of the middle one. While sitting on the south side of the monument at twelve o'clock, we put the thermometer in a favorable place and it went up to 84 degrees. At the same time, on the north side, and six feet from us, water was freezing, and the snow dry and crusty. Near by the monument a rock stood in its natural position, having a sharp peak in

the top. This was the highest one of the kind. Of this about four inches were broken off, and one of the company carried it home with the conviction that he had lowered the height of Katahdin to that amount. About two P. M. we rturned to the eastern peak. It may be well to pause here and take a re-survey of the scene thus far presented, and as much more as can be viewed from this point.

From this eastern peak a spur makes out eastward one mile. Half a mile down, however, it divides, and a branch runs to the north-east the same distance. On the south-west, across the cut, is the Chimney. From this the line of peaks and hammocks curves to the west till it reaches the middle and highest peak. From one hammock to the other there are, in all, thirty rods of narrow pass. Some of them are so narrow that a man could drop a stone from either hand and it would go to unknown depths below. In some places the only possible way is over the top, and only one foot wide. For a great part of the time the wind blows across these passes so violently that the stones themselves have to be firmly fixed to keep their places. It seemed remark-

able, as if for our convenience, that the day of our visit was still and quiet. From the middle peak the line curves to the north-west to the further monument. From this point a branch makes down to the south-west, having on it some extensive table-land, while the top ridge or curve turns directly north with the sag. At the bottom of the sag we come upon a wide flat, which runs north half a mile, and stretches out to a considerable width. At the northern extremity of the flat, the ridge curves to the east, and rises to a peak about equal in height to the eastern peak of the northern wing. This is probably the highest of the northern peaks, from which a spur makes down, a little south of east, to within one quarter of a mile from the one that comes from the southern wing. All this nearly encircles a deep basin with walls almost perpendicular, and in some places apparently two thousand feet high.

To survey the bottom of this basin I have since made a separate journey. It contains, perhaps, two hundred acres, covered with large square blocks of granite that seem to have come from the surrounding walls. There are,

in all, six lakes and ponds, varying in size from two to ten acres. One of them I crossed on ice the 15th of October. From its outlet inward to the south-west is about a mile, where there is a small lake of clear water which has no visible outlet, so far as I can learn. I was the first human visitor to this fabled residence of the Indian Pamolah. It is not strange that a superstitious people should have many traditions of his wonderful pranks, and be kept away from close engagement with such a foe. When we reach the lake on our way to Katahdin, it is easy to see the origin of those fears which the Indians are said to have respecting the mountain as the residence of Pamolah or Big Devil. Clouds form in the basin and are seen whirling out in all directions.

Tradition tells a long yarn about a handsome squaw among the Penobscots, who once did a great business in slaying her thousands among the young chiefs of her nation, but was finally taken by Pamolah to Katahdin, where he now protects himself and prize from approaching Indians with all his artillery of thunder and hail. The Indians say it is sartin

true, cause handsome squaws always kitch em debbil. Whether this be true or not, the basin is the birth-place of storms, and I have myself heard the roar of its winds for several miles. But on the 15th of October when we entered it and went to the upper lake, all was still as the house of nymphs, except when we ourselves spoke, and then the thousand echoes were like the response of fairies bidding us welcome. In this way the music of our voices would find itself in the midst of a numerous choir singing a round.

The upper lake which we visited, has an inlet, a white pearly brook, coming out nearly under the Chimney, and running a short distance through alders and meadow grass. It has no visible outlet; but on the north side it seems to ooze out among the rocks. We can trace this water-course curving to the east of north till it reaches the lower and largest lake, from which flows a brook sufficiently large for trout to run up. This brook curves to the south, running into the west branch, and is called Roaring Brook. The mountain around this basin is in the form of a horse shoe, opening to the north-east. From the peak on the

northern wing there is another deep gorge, partly encircled with a curving ridge, which some would call another basin.

On the north side of this gorge there is a peak nearly equal in height to the one on the south of it, but considerably further east, making this northern basin or gorge open to the south-east. These two basins from some points of view seem to be one. From the last mentioned peak the mountain slopes off from one peak or shoulder to another, perhaps three miles, before it reaches the timber growth. Some of the branches of the Wassataquoik come from this northern part, but some of them from the basin or southern part of Katahdin.

Rough granite, moss-covered rocks are spread over its whole surface, from the short growth upward. Blueberries and cranberries grow far up the sides. At the time of our visit considerable snow lay on its summit, and lined the walls of the great basin. The party, of course, found plenty of drink; the Avalanche Brook, having its source about the middle of the slide, furnished water as pure as crystal.

The ascent was attended with some danger and fatigue. But what a view when the utmost heights are gained. What a magnificent panorama of forests, lakes, and distant mountains. The surface of the earth, with its many-tinted verdure, resembled in form and smoothness the swelling sea. In the course of the forenoon, light fogs ascended, and coming to Katahdin, interwinded themselves most fantastically above our heads, then settled down and dispersed. But what can be fitly said about the vast expanse of the heavens to be seen from such an elevation, especially when the sun goes down, and the glowing stars appear in silent majesty. All the gorgeous, artificial brilliancy of man's invention is more than lost in the comparison. Language has no power to describe a scene of this nature. The height of Katahdin above the level of the sea is five thousand three hundred feet. Its position is isolated, and its structure an immense curiosity. From its summit very few populous places are visible, so extensive is the intervening wilderness. On its sides the growth of wood is beautiful, presenting a regular variation in altitude and

size all the way up to the point where it ceases.

The great basin described by Mr. Keep was to none of us an inferior object of interest. Want of time and strength prevented our descent into it. It is open to general inspection from all the heights around it. The day being quiet, the view was divested of much of its terror; but we could readily believe it the abode of all the furies in a storm, and where the polar monarch has his chief residence in Maine. We called to each other across the basin, and each answered, where! in earnest. The air was exhilarating, as may be supposed, but the effect not as sensible as we anticipated.

The whole party returned to the head of the slide at three P. M., and engaged in picking cranberries. These grow on all parts of the mountain above the timber region, and no doubt annually yield many thousand bushels. They grow on vines among the rocks, and are commonly called the mountain or highland cranberry. They are smaller than the meadow cranberry, but of a better flavor.

At four o'clock six of the party went down to the camp to prepare fuel for the Sabbath.

Our guide and the gunner remained at the head of the slide all night, and kept a fire with old roots; yet it was presumed that they had now and then a little cold comfort. The result of their stay is thus set forth by Mr. Keep: On Sabbath morning the eastern horizon was clear of clouds, and we looked anxiously for the sun. Just before it came up, a bright streak appeared of silver whiteness, like the reflected light of the moon. We could see further outline of land quite plain, and for a short distance beyond this silvery streak. Soon a small arc of the sun appeared above this bright line, and I was hardly able to control my emotions while the whole came in sight. On Saturday night, about sundown, our view of the country around was more distinct and enchanting, a boundless wilderness in all directions, much of the view being south of the lake. Of the latter, not far from two hundred lakes are to be seen dotting the landscape. In one of them we can count one hundred islands. Soon after sunrise on Sabbath morning we went down to camp to spend the day with the company.

That holy morning found us refreshed, and

somewhat prepared to appreciate our peculiar circumstances. The weather was charming. The air resounded with the pleasing murmur of the Avalanche Brook, as it flowed down over its bed of rocks; nor was the song of birds denied us. Gentle breezes stirred the beautiful foliage of the circling woods. Impressive stillness reigned, and the whole scene was adapted to awaken happy and exuberant emotions.

Early we mounted some rocks on the bank of the stream toward the rising sun, and overlooking a vast region of country, and there poured forth sacred melody to our hearts' content. The echo was glorious. Verily we thought our feet were set in a large place; and we could readily imagine that the wide creation had found a tongue with which our own exulted in unison. At the hour appointed we assembled in camp, and engaged in the exercises of religious conference. It was good to be there. The scene finds its portration in the words of Cowper:

> The calm retreat, the silent shade,
> With pray'r and praise agree,
> And seem by thy sweet bounty made,
> For those who follow thee.

Then, if thy spirit touch the soul,
And grace her mean abode,
O! with what peace, and joy, and love,
She there communes with God.

It is not too much to say that we enjoyed a measure of such experience. The day, the place, the topics of remarks, the songs of Zion, all encircled by a kind Providence, and made effective by the presence of God, will ever be worthy of a grateful remembrance.

The Penobscot has two principal, and many minor branches; among the latter, mention may be made of the Matawamkeag, which means a stream running over a gravelly bed; and the Piscataquis, which is about one hundred miles in length, and forms a junction with the main river some thirty or forty miles above Bangor; its waters are clear as crystal, and the current rapid. Also, the Seboois, several day's journey from the mouth of the Matawamkeag.

Some of the wildest and most interesting scenery in this State occurs on this river, and on the lofty mountains in its vicinity. Godfrey's Falls plunge around the base of high mountainous banks, hundreds of feet above the wild torrent which rushes between them.

These falls are impassable, and when boatmen arrive here they are compelled to carry their effects and boats up a ledge on the left side of the falls, at an angle of 45 degrees, and then through the burned forest for the distance of four miles, before again attempting to navigate the river.

Not less than fifty mountains and seventeen lakes may be seen from the summit of Sugar-Loaf Mountain, which stands a little removed from the shores of the Seboois River; and among the interesting objects viewed from this point is Chase's Mountain, on the west side of the Seboois, very peaked, which rises like a vast pyramid from the dense forest country around it.

There are many important islands in the Penobscot River; several of them contain many hundred acres of land. Among them mention may be made of Olemon, which contains some three hundred acres; likewise Sugar Island, of corresponding magnitude; Orson Island, twelve hundred acres; Marsh Island, five thousand acres; Oldtown, the present site of an Indian village, three hundred acres; Orono, one hundred and fifty acres. On these

islands are several flourishing villages, Old-town, Orono and Stillwater, in the vicinity of which are the principal mill sites, which are from seven to fourteen miles above Bangor, the great lumbering district.

In addition to the natural resources of the Penobscot for lumber, several townships of good pine timbered land, formerly claimed by the English Crown, but by the treaty of 1842 it was ceded to the United States, have become available by diverting a portion of the head waters of the St. John's River into the channel of the Penobscot. This was effected by cutting a canal from a lake on the St. John's River, called Zelos, to Webster Lake on the Penobscot. Originally the canal was three hundred rods long by four wide, and four feet deep; but the strong current of water flowing through, at the rate of one mile in twenty minutes, has changed the regularity of the channel to a more natural stream-like appearance.

By this hit of Yankee enterprise, the timber of eight townships, otherwise and necessarily destined for the provincial market, may be brought down the Penobscot, the aggregate

amount of which is estimated, by the best judges, at five hundred millions of feet. This has succeeded so well, that further surveys have been made with a view to open other communications between the waters in the same region, and, if the expectations of those interested be realized, it is said the timber of some thirty townships more will come down the Penobscot River. The project of excavating the canal alluded to, was suggested by the proximity of the above-named lakes, and the remarkably favorable position of the strip of land lying between them. The direct cause of its being carried into effect is said to have originated in consequence of the levying of a provincial tax on lumber cut and run down the St. John's River by Americans, in violation of an article in the treaty adopted by the two Governments in the recent settlement of the boundary between Maine and New Brunswick. The specific condition in the treaty thought to have been violated is this in substance: All timber situated on land ceded to the United States, which, from its position, must pass down the St. John's, shall be dealt with as if it were the product of said

province, which condition on the part of Maine, was thought to imply freedom from duty or taxation.

LARGE TREES OF PINE.

Mankind, pretty generally, are disposed to place the oak at the head of the vegetable kingdom, and it is crowned monarch of the forest.

> The oak for grandeur, strength, and noble size,
> Excels all trees which in the forest lies.

The pine has, by some, been called the monarch of the forest. Taken all in all, it is the crowning master-piece of all woody plants. Properly there are but three species of the pine: 1st. The White Pine. 2d. Pitch Pine. 3d. The Norway or Red Pine, as it is sometimes called. The red pine is remarkable for its tall trunk; it sometimes rises eighty feet before it puts out a limb. There was one cut on the Matawamkeag River, which empties into the Penobscot River, which measured eighty feet before reaching a limb. They are sometimes found one hundred feet in height and four feet in diameter. The pitch pine is inferior to the red in size. The largest, of

which we have any account, was ninety feet in height and two and a half feet in diameter. At present the white pine is altogether the most important of the species. In New England, particularly in the northern part, it is often found to measure one hundred and fifty feet in height.

It is said that not many years since, pines were found in the eastern part of New York which measured two hundred and forty feet in height. Lambert's Pine, on the north-west coast, is found growing to the height of two hundred and thirty feet, and Douglas' Pine, in the same region, the loftiest known, has been said to exceed three hundred feet.

A traveler describes one of the following dimensions: One specimen, which had been blown down by the wind, and this was certainly not the largest which I saw, was of the following dimensions: its length was two hundred and fifteen feet; its circumference, three feet from the ground, was fifty-seven feet nine inches, (nineteen feet three inches in diameter,) and at one hundred and thirty-four feet from the ground it was seventeen feet five inches in circumference, or about six feet in diameter.

In Dr. Dwight's travels we have an account of a tree in Lancaster, New Hampshire, which measured two hundred and sixty-four feet in length.

A writer in the *Revue Horticale*, says he went to see two trees said to be the largest in the world. Both of them were on the border of a small stream tributary to the river of the North-west Bay, in the rear of Mount Wellington. These trees were there called Swamp Gum. He and his four companions measured them. One of them had fallen; we therefore easily obtained its dimensions. We found its body two hundred and twenty feet from the ground to the first branch. The top had broken off and partly decayed, but we ascertained the entire height of the tree to have been certainly three hundred feet, the diameter at the base of it to be thirty feet, and at the first branch twelve feet. The other tree, now growing, three feet above the ground measured one hundred and two feet in circumference.

There appears to be a want of uniformity of sentiment in regard to trees, as to which is entitled to hold the first rank in the vegetable

kingdom. In the days of King David and Solomon, the noble Cedars of Lebanon held the pre-eminence, and were celebrated in verse as emblems of beauty, grandeur, and especially of durability; but with the moderns the cedar is emblematical of sadness and mourning.

"Dark tree! still sad when earth's grief is fled—
The only constant mourner of the dead."—BYRON.

Perhaps the oldest tree of record is the Cypress of Somma, in Lombardy. It is supposed to have been planted in the year of the birth of Christ, and on that account is looked upon with reverence by the inhabitants; but an ancient chronicle at Milan is said to prove that it was a tree in the time of Julius Cæsar, 42 years B. C. It is one hundred and twenty-three feet high, and twenty-three feet in circumference at one foot from the ground. Napoleon, when laying down the plan for his great road over the Simplon, diverged from a straight line to avoid injuring this tree.

The cedar was styled the glory of Lebanon. The temple of Solomon, and that of Diana at Ephesus, were built of this wood. The number of these trees is now greatly diminished. They were often of vast size, sometimes girt-

ing thirty-six feet, perfectly sound, with a lofty height, whose spreading branches extended one hundred and ten feet. The durability of the cedar is said to be attributable to two qualities, first the bitterness of the wood, which protects it from the depredations of worms; and secondly, its resin, which preserves it from the injuries of the weather.

To the oak some assign the first rank. It is celebrated in the East, and by many of the ancients was regarded with religious veneration. In the West, and by moderns, it is employed more as an emblem of the strength, compactness, and durability of the state.

The religious veneration paid to the tree by the original natives of Britain, in the time of the Druids, is well-known in British history. The patriarch Abraham resided under an oak, or a grove of oaks; and it is believed that he planted a grove of this tree. In hot countries nothing is more desirable than the shade of a tree or trees.

> "Where'ere the oak's thick branches spread
> A deeper, darker shade."

Oaks and groves of oaks were esteemed proper places for religious services; altars

were set up under them; affairs of state were discussed and ratified under their ample shade. Abimelech was made king under an oak. Absalom rode upon a mule which went under the thick boughs of a great oak, and his head was caught in the branches, and by them was held up between the heaven and the earth, and while there suspended, was slain by Joab and his armor-bearers. The Charter Oak, which formerly stood in Hartford, Connecticut, is said to have measured at the ground thirty-six feet; and in the smallest place above it was eight feet four inches in diameter.

The Oriental Plane Tree holds the same place on the Eastern Continent, which our Button-Wood does in this. It was a great favorite among the ancients. Pliny describes some of the most remarkable Oriental Plane Trees. In the walks of the Academy at Athens were trees whose trunks were about forty-eight feet from the ground to the branches. In his own time there was one in Lycia, near a cool fountain by the road-side, with a cavity of eighty-one feet circuit within its trunk, and a forest-like head, and arms like trees overshadowing broad fields. Within

this apartment, made by moss-covered stones to resemble a grotto, Licinius Mucianus thought it a fact worthy of history, that he dined with nineteen companions, and slept there too. General Washington measured a button-wood on an island in the Ohio River, and found its girth to be forty feet at five feet from the ground. In 1842 another button-wood was found on the bank of the Ohio, 36 miles from Marietta, which measured forty-seven feet in circumference, or fifteen feet eight inches in diameter.

LARGE TREE OF SOUTH AMERICA.

A tree of Guayra, South America, named Zamang, is known over the whole province for the enormous extent of its branches, which form a hemispherical top of 614 feet in circumference. The zamang is a beautiful species of mimosa, whose tortuous branches divide by forking. Its slim and delicate foliage is agreeably detached on the blue of the sky. The tree is not more than 64 feet high and nine and one-half feet in diameter. The real beauty consists in the general form of its top. The branches stretch out like the spokes

of a great umbrella, and all incline towards the ground, from which they uniformly remain twelve or fifteen feet distant.

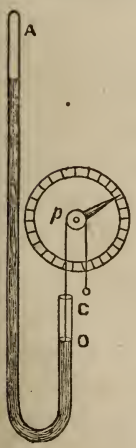
COW TREE IN SOUTH AMERICA.

The Cow Tree of South America yields milk which answers in place of milk from the cow. The cow tree grows on the parched side of the rocks, with dry and leathery foliage, its large, woody roots scarcely penetrating into the ground. For several months in the year its leaves are not moistened by a shower; but when the trunk is bored a bland and nourishing milk flows from it. It is at sunrise that the vegetable fountain flows most freely. At that time the blacks and natives are seen coming from all parts with large bowls to receive the milk, which grows yellow and thickens at the surface

MEASUREMENT OF HEIGHTS BY THE WHEEL BAROMETER.

In the barometer formerly used, the rise and fall of the mercury is indicated by a scale of inches and tenths of inches, fixed behind the tube; but it has been found that very slight variations in the density of the atmosphere are not readily perceived by the former construction of the barometer. It being desirable that the minute changes should be rendered more obvious, a contrivance for increasing the scale, called the wheel barometer, was invented.

DESCRIPTION OF THE WHEEL BAROMETER.



The whole length of this barometer is 34 or 35 inches, and it is filled with mercury as usual. The mercury rises in the short leg to the point *o*, where there is a small piece of glass floating on its surface, to which there is attached a silk string, passing over the pulley *p*. To the axis of the pulley is fixed an index, or hand, and behind this is a graduated circle as seen in the figure. It is obvious that a very

slight variation in the height of the mercury at *o*, will be indicated by a considerable motion of the index, and thus changes in the weight of the atmosphere, hardly perceptible by the common barometer, will become quite apparent by this.

HEIGHTS MEASURED BY THE BAROMETER.

The mercury in the barometer tube being sustained by the pressure of the atmosphere, and its medium altitude at the surface of the earth being about twenty-nine inches, it might be expected that if the instrument was carried to a height from the earth's surface, the mercury would suffer a proportionate fall, because the pressure must be less at a distance from the earth than at its surface, and experiment proves this to be the case. When, therefore, this instrument is elevated to any considerable height, the descent of the mercury becomes perceptible. Even when it is carried to the top of a hill or very high tower, there is a sensible depression of the fluid; so that the barometer is employed to measure the height of mountains, and the elevation to which balloons ascend from the surface of the

earth. On the top of Mont Blanc, which is about 16,000 feet above the level of the sea, the medium elevation of the mercury in the tube is only 14 inches, while on the surface of the earth, as above stated, it is 29 inches.

PRINCIPLES OF THE BAROMETER APPLIED TO THE WATER PUMP.

Although the medium range of the barometer in Europe is usually calculated at 29 inches, on the level of the sea, it does not appear, as might be expected, that the pressure of the atmosphere is everywhere the same; since, from observations made in Cambridge, Massachusetts, for the term of twenty-two years the medium range was there nearly thirty inches. Now, on comparing the specific gravity of mercury with that of water, it is found that 29 or 30 inches of mercury are equal to 33 or 34 feet of water, and hence this is the height to which water can be raised by the atmospheric pump on the level of the sea.

By experiments it is proved that the weight or pressure of the atmosphere is equal to the weight of a perpendicular column of water,

from 33 to 34 feet high at the level of the sea, as above stated. As you ascend above the level of the ocean the pressure of the atmosphere grows less in proportion to the height you ascend above that level. Therefore, it is evident that a column of water will not rise as high in the pump or other tubes on a mountain as it will at the level of the sea, because the weight of the atmosphere is less on the mountain; therefore the pressure of the atmosphere is less on the surface of the water on the outside of the pump or tube, consequently the water will only rise in the pump exactly in proportion to the outward pressure upon the water.

The weight or density of the atmosphere may be compared to several fleeces of wool piled one upon another. By this you will see that the bottom fleece is more dense or harder pressed than the one above it; the second fleece is more dense and harder pressed than the one above it; the third fleece is harder pressed than the one above it, and less dense or lighter pressed than the one below it; thus you can continue the pile to any height, and the top fleece having no weight upon it will

lie up loose and lighter than any one below it. Thus you see the density or pressure decreases as you ascend, and increases as you descend. The same with the atmosphere which surrounds the globe to the height of forty-five miles above the surface of the globe, and like the pile of wool, the upper portion of the atmosphere resting upon the lower; therefore it is evident that the pressure of the atmosphere diminishes as you ascend the hills or mountains, or any other elevation, and the pressure of the atmosphere is fifteen pounds to the square inch.

Now, as the efficacy of the pump depends on the pressure of the atmosphere, the barometer will always indicate the height to which water can be raised at any given place. Thus, on Mont Blanc, where the barometer stands at only fourteen inches, being less than one-half its height on the sea level, the water pump would only raise the fluid about fifteen feet. Hence, engineers and others who visit elevated countries should calculate by the barometer, from what depth they can raise water by aerial pressure, before they erect works for this purpose.

At the cities of Mexico and Quito, for instance, the suction tube can only act to the depth of twenty or twenty-two feet, while on the Himalaya Mountains its rise will be only about eight or ten feet.

USE AS A WEATHER GLASS.

While the barometer stands in the same place, near the level of the sea, the mercury seldom or never falls below twenty-eight inches, or rises above thirty-one inches; its whole range, while stationary, being only about three inches. These changes in the weight of the atmosphere indicate corresponding changes in the weather; for it is found, by watching these variations in the height of the mercury, that when it falls, cloudy or falling weather ensues, and that when it rises, fine weather may be expected. During the time when the weather is damp and lowering, and the smoke of chimneys descends towards the ground, the mercury remains depressed, indicating that the weight of the atmosphere during such weather is less than it is when the sky is clear. This contradicts the common opinion that the air is the heaviest when it

contains the greatest quantity of fog and smoke, and that it is the uncommon weight of the atmosphere which presses these vapors towards the ground.

A little consideration will show that in this case the popular belief is erroneous, for not only the barometer, but all the experiments we have detailed on the subject of specific gravity, tend to show that the lighter any fluid is the deeper any substance of a given weight will sink in it. Common observation ought, therefore, to correct this error, for everybody knows that a heavy body will sink in water while a light one will swim, and by the same kind of reasoning ought to consider that the particles of vapor would descend through a light atmosphere, while they would be passed up into higher regions by a heavier air.

The following indications of the barometer, with respect to the weather, may be depended on as correct, being tested by the observations of many:

I. In calm weather, when the wind, clouds, or sun indicates approaching rain, the mercury in the barometer is low.

II. In serene, fine, settled weather, the mercury is high, and often remains so for days.

III. Before great winds, and during their continuance, from whatever quarter they come, the mercury sinks lowest, and especially if they come from the south.

IV. During the coldest, clear days, when a gentle wind from the north or west prevails, the mercury stands highest.

V. After great storms, when the mercury has been lowest, it rises most rapidly.

VI. It often requires considerable time for the mercury to gain its wonted elevation after a storm; and, on the contrary, it sometimes rains without the usual corresponding change in its altitude.

VII. In general, whether there are any appearances of change in the horizon or not, we may prognosticate rain whenever the mercury sinks during fine weather.

VIII. When it rains with the mercury high, we may be sure that it will soon be fair.

USE OF THE BAROMETER AT SEA.

The principal use of the barometer is on board of ships, where it is employed to indi-

cate the approach of storms, and thus to give opportunity of preparing for a storm or a hurricane; and it is found that the mercury suffers a most remarkable depression before the approach of violent winds or hurricanes. The watchful captain, particularly in southern latitudes, is always attentive to this monitor, and when he observes the mercury to sink suddenly, takes his measures without delay to meet the tempest. During a violent storm we have seen the wheel barometer sink a hundred degrees in a few hours. But we cannot illustrate the use of this instrument at sea better than to give the following extract from Dr. Arnot, who was himself present at the time. "It was," he says, "in a southern latitude. The sun had just set with a placid appearance, closing a beautiful afternoon; and the usual mirth of the evening watch proceeded, when the captain's orders came to prepare with all haste for a storm. The barometer had begun to fall with appalling rapidity. As yet, the oldest sailors had not perceived even a threatening in the sky, and were surprised at the extent and hurry of the preparations; but the required measures were not

completed, when a more awful hurricane burst upon them than the most experienced had ever braved. Nothing could withstand it, the sails already furled, and closely bound to the yards, were riven into tatters; even the bare yards and masts were in a great measure disabled; and at one time the whole rigging had nearly fallen by the board. Such for a few hours was the mingled roar of the hurricane above, and the waves around, and the incessant peals of thunder, that no human voice could be heard, and amid the general consternation even the trumpet sounded in vain. On that awful night, but for a little tube of mercury which had given the warning, neither the strength of the noble ship, nor the skill and energy of her commander would have saved one man to tell the tale."

TRAVELS IN SOUTH AMERICA BY ALEXANDER VON HUMBOLDT AND OTHERS.

TOUR AND VISIT TO THE MISSIONS OF THE CHAYMAS INDIANS.

This is a Spanish Catholic mission. On the fourth of September, at an early hour, our travelers commenced the excursion to this missionary station and to the lofty mountains of New Andalusia. The morning was deliciously cool; and from the summit of the hill named San Francisco they enjoyed, in the short twilight, an extensive view of the sea, the adjacent plain, and the distant peaks of mountains. There being no wagon roads in this country, nothing but trails or paths, after walking two hours they arrived at the foot of the chain of mountains, where they found different rocks, together with a new and more luxuriant vegetation. They observed that the latter was more brilliant wherever

the limestone was covered by a quartzy sandstone, a circumstance which probably depends not so much on the nature of the soil as on its greater humidity; the thin layers of slate-clay, which the latter contains, preventing the water from filtering into the crevices of the rocks. In those moist places they always discovered appearances of cultivation, huts inhabited by mestizoes, and placed in the centre of small enclosures, containing papaws, plantains, sugar canes and maize.

In the torrid zone, where the fertility of the soil is proportionate to the heat and humidity of the air, and where man has appropriated plants that yield earlier and more abundant crops, an immense population finds ample subsistence on a narrow space. The scattered disposition of huts in the midst of the forest indicates to the traveler the fecundity of nature. In so mild and uniform a climate the only urgent want of man is that of food; and in the midst of abundance his intellectual faculties receive less improvement than in colder regions, where his necessities are numerous and diversified. In the warmest parts of South America, populous provinces seem to

the traveler almost deserted, because a very small extent of soil is sufficient for the maintenance of a family. The insulated state in which the natives thus live prevents any progress of civilization, although it develops the sentiments of independence and liberty.

As the travelers penetrated into the forests the barometer indicated the progressive elevation of the land. About three in the afternoon they halted on a small flat, where a few houses had been erected near a spring, the water of which they found delicious. Its temperature was 72.5 degrees, while that of the air was 83.7 degrees. From the top of a sandstone hill in the vicinity, they had a splendid view of the sea and part of the coast, while in the intervening space the tops of trees, intermixed with flowery lianas, formed a vast carpet of deep verdure. As they advanced toward the south-west the soil became dry and loose. They ascended a group of rather high mountains, destitute of vegetation, and having steep declivities. This ridge is named the Impossible, it being imagined that in case of invasion it might afford a safe retreat to the inhabitants of Cumana. The prospect was

finer and more extensive than from the fountain above mentioned. They arrived on the summit only a little before dusk. The setting of the sun was accompanied by a very rapid diminution of temperature, the thermometer suddenly falling from 77.4 degrees to 70.3 degrees, although the air was calm.

They passed the night in a house at which was a military party of eight men, commanded by a Spanish sergeant. When, after the capture of Trinidad by the English, in 1797, Cumana was threatened, many of the people fled to Cumanacoa, leaving the more valuable of their property in sheds constructed on this ridge. The solitude of the place reminded Humboldt of the nights which he had passed on the top of St. Gothard. Several parts of the surrounding forests were burning, and the reddish flames arising amid clouds of smoke presented a most impressive spectacle. The shepherds set fire to the woods for the purpose of improving the pasturage, though conflagrations are often caused by the negligence of the wandering Indians. The number of old trees on the road from Cumana to Cumanacoa has been greatly reduced by these accidents; and

in several parts of the province the dryness has increased, owing both to the diminution of the forests and the frequency of earthquakes, which produce crevices in the soil.

Leaving the Impossible on the 5th, before sunrise, they descended by a very narrow path bordering on precipices. The summit of the ridge was of quartzy sandstone, beneath which the alpine limestone reappeared. The strata being generally inclined to the south, numerous springs gush out on that side, and in the rainy season from torrents which fall in cascades, shaded by the hura, the cuspa, and the trumpet-tree. The cuspa, which is common in the neighborhood of Cumana, had long been used for carpenter work, but has, of late, attracted notice as a powerful tonic or febrifuge.

Entering from the ravine which opens at the foot of the mountain, they entered a dense forest traversed by numerous small rivers, which were easily forded. They observed that the leaves of the cecropia were more or less silvery, according as the soil was dry or marshy, and specimens occurred in which they were entirely green on both sides. The roots

of these shrubs were concealed beneath tufts of dorstenia, a plant which thrives only in shady and moist places. In the midst of the forest they found papaws and orange trees bearing excellent fruit, which they conjectured to be the remains of some Indian plantations, as in these countries they are no more indigenous than the banana, the maize, the manioc, and the many other useful wants of the people whose native country is unknown, although they have accompanied man in his migrations from the most remote periods.

When a traveler newly arrives from a northern clime, (says Humboldt,) and penetrates for the first time into the forests of South America, nature presents herself to his view in an unexpected aspect; the objects by which he is surrounded bear but faint resemblance to the pictures drawn by celebrated writers on the banks of the Mississippi, in Florida, and in other temperate regions of the New World. He perceives at every step that he is not upon the verge, but in the centre of the torrid zone—not in one of the West India Islands, but upon a vast continent, where the mountains, the rivers, the mass of vegeta-

tion, and everything else are gigantic. If he be sensible to the beauties of rural scenery, he finds it difficult to account to himself for the diversified feelings which he experiences. He is unable to determine what most excites his admiration; whether the solemn silence of the wilderness, or the individual beauty and contrasts of the forms, or the vigor and freshness of vegetable life, that characterize the climate of the tropics. It might be said that the earth, overloaded with plants, does not leave them room enough for growth. The trunks of the trees are everywhere covered with a thick carpet of verdure; and were the orchieae and the plants of the genera piper and pothos, which grow upon a single courbaral or American fig tree, transferred to the ground, they would cover a large space. By this singular denseness of vegetation, the forests, like the rocks and mountains, enlarge the domain of organic nature. The same lianas which creep along the ground rise to tops of the trees, and passes from one to the other at a height of more than a hundred feet. In consequence of this intermixture of parasitic plants, the botanist is often led to con-

found the flowers, fruits and foliage which belong to different species. The philosophers walked for some hours under the shade of these arches, which scarcely admitted an occasional glimpse of the clear blue sky, and for the first time admired the pendulous nests of the orioles, which mingled their warblings with the cries of the parrots and macaws. The latter fly only in pairs, while the orioles are seen in flocks of several hundreds. At the distance of about a league from the village of San Fernando, they issued from the woods and entered an open country, covered with aquatic plants from eight to ten feet high; there being no meadows or pastures in the lower parts of the torrid zone. The road was bordered with a kind of bamboo, rising more than forty feet. These plants, according to Humboldt, are less common in America than is usually supposed, although they form dense woods in New Grenada and Quito, and occur abundantly on the western slope of the Andes.

They now entered San Fernando, which is situated in a narrow plain, and bounded by limestone rocks. This was the first missionary station they saw. The houses of the Chayma

Indians were built of clay, strengthened by lianas, and the streets were straight and intersected each other at right angles. The great square in the centre of the village contains the church, the house of the missionary, and another destined for the accomodation of travelers, which bears the pompous name of the King's House, (Casa del Rey). These royal residences occur in all Spanish settlements, and are of the greatest benefit in countries where there are no taverns.

They had been recommended to the friars who superintend the missions of the Chaymas, by their syndic at Chumana, and the superior, a corpulent and jolly old capuchin, received them with kindness. This respectable personage, seated the greater part of the day in an arm chair, complained bitterly of the indolence of his countrymen. He considered the pursuits of the traveler as useless, smiled at the sight of their instruments and dried plants, and maintained that of all the enjoyments of life, without exception, none could be compared with the pleasure of eating good beef. This mission was founded about the end of the seventeenth century, near the junction of the

Manzanares and Lucasperez; but in consequence of a fire, was removed to its present situation. The number of families now amounted to a hundred, and as the head of the establishment observed, the custom of marrying at a very early age contributed greatly to the rapid increase of population.

In the village of Arenas, which is inhabited by Indians of the same race as those of San Fernando, there lived a laborer, Francisco Lozano, who had suckled a child. Its mother happening to be sick, he took the child in order to quiet it, pressed it to his breast, when the stimulus imparted by the sucking of the child caused a flow of milk. The travelers saw the certificate drawn up on the spot to attest this remarkable fact, of which several eye-witnesses were still living. The man was not at Arenas during their stay at the mission, but afterwards visited them at Cumana, accompanied by his son, when M. Bonpland, one of the travelers, examined his breasts and found them wrinkled like those of women who have nursed. He was not an Indian, but a white, descended from European parents. Alexander Benedictus relates a similar case of

an inhabitant of Syria, and other authors have given examples of the same nature.

Returning towards Cumana, they entered the small town of Cumanacoa, situated in a naked and almost circular plain, surrounded by lofty mountains, and containing about twenty houses, low and slight and with very few exceptions built of wood. The travelers were surprised to find the column of mercury in the barometer scarcely 7.3 lines shorter than on the coast. The hollow in which the town is erected is not more than 665 feet above the level of the sea, and only seven leagues from Cumana; but the climate is much colder than in the latter place, where it scarcely ever rains, whereas at Cumanacoa there are seven months of severe weather.

It was during the winter season that our travelers visited the missions. A dense fog covered the sky every night; the thermometer varied from 64.8 degrees, and Deluc's hydrometer indicated 85 degrees. At ten in the morning the thermometer did not rise above 69.8 degrees, but from noon to three o'clock attained the height of from 78.8 degrees to 80.6 degrees. About two, large black clouds,

regularly formed, poured down torrents of rain, accompanied by thunder. At five the rain ceased, and the sun reappeared; but at eight or nine the fog again commenced. In consequence of the humidity, the vegetation, although not very diversified, is remarkable for its freshness. The soil is highly fertile; but the most valuable production of the district is tobacco, the cultivation of which, in the province of Cumana, is nearly confined to this valley. Next to the tobacco of Cuba and the Rio Negro, that grown here is the most aromatic. This singular plain appeared to be the bed of an ancient lake. The surrounding mountains are all precipitous, and the soil contains pebbles and bivalve shells. The mountains are inhabited by jaguars, which pass the day in caves, and roam about the plantations at night. The jaguars had caught a horse, and while killing it the groans of the dying animal awoke the slaves, who went out armed with lances and large knives, with which they dispatched the tiger after a vigorous resistance.

From the caverns in this ravine there at times issue flames which illuminate the adjacent mountains, and are seen to a great distance at

night. The phenomenon was accompanied by a long-continued subterranean noise at the time of the last earthquake. A first attempt to penetrate into this was rendered unsuccessful by the strength of the vegetation and the intertwining lianas and thorny plants; but the inhabitants becoming interested in the researches of the travelers, and being desirous to know what the German miner thought of the gold ore which they imagined to exist in it, cleared a path through the woods. On entering the ravine they found traces of tigers; and the Indians returned for some small dogs upon which they knew these animals would spring in preference to attack a man.

The rocks that bound it were perpendicular, and what geologists term Alpine limestone. The excursion was rendered hazardous by the nature of the ground, but they at length reached the pretended gold mine, which was merely an excavation in a bed of black marl containing iron pyrites, a substance which the guides insisted was none other than the precious gold metal. They continued to penetrate into the crevice, and after rising perpendicularly to the height of 5,116 feet, discovered two

inaccessible caverns inhabited by nocturnal birds. Halting at the foot of one of the caves, from which flames had been seen to issue, they listened to the voice of the natives respecting the probability of an increase in the frequency of the agitations to which New Andalusia had so often been subjected. The cause of the luminous exhalations, however, they were unable to ascertain. On the 12th they continued their journey to the convent of Caripe, the principal station of the Chayma missions, choosing, instead of the direct road, the line of mountains, Cocollar and Turimiquiri. At the Hato de Cocollar, a solitary farm situated on a small elevated plain, they rested for sometime, and had the good fortune to enjoy at once a delightful climate and the hospitality of the proprietor. From this elevated point, as far as the eye could reach, they saw only naked savannas; although in the neighboring valleys they found tufts of scattered trees, and a profusion of beautiful flowers. The upper part of the mountain was destitute of wood, though covered with gramineous plants, a circumstance which Humboldt attributes more to the custom of burn-

ing the forests than to the elevation of the ground, which is not sufficient to prevent the growth of trees.

Their host, Don Mathias Yturburi, a native of Biscay, had visited the New World with an expedition, the object of which was to form establishments for procuring timber for the Spanish navy. But these natives of a colder climate were unable to support the fatigue of so laborious an occupation, the heat and the effect of noxious vapors and destructive fevers carried off most of the party, when this individual withdrew from the coast, and settling on the Cocollar, became the undisturbed possessor of five leagues of savannas, among which he enjoyed independence and health.

Nothing, says Humboldt, can be compared to the impression of the majestic tranquility left on the mind by the view of the firmament in this solitary place. Following with the eye, at evening-tide, meadows which stretch along the horizon and the gently undulated plain covered with plants, we thought we saw in the distance, as in the deserts of the Orinoco, the surface of the ocean supporting the

starry vault of heaven. The tree under which we were seated, the luminous insects that vaulted in the air, and the constellations which shone in the south, seemed to tell us we were far from our native land. In the midst of this exotic nature, when the bell of a cow or the lowing of a bull was heard from the bottom of the valley, the remembrance of our country was suddenly awakened by the sound. They were like distant voices that came from beyond the ocean, and by the magic of which were transported from the one hemisphere to the other. Strange mobility of the human imagination, the never-failing source of our enjoyments and griefs. In the cool of the morning they commenced the ascent of Turimiquiri, the summit of the Cocollar, which with the Brigantine, forms a mass of mountains, formerly named by the natives the Sierra de los Tageres. They traveled part of the way on horses, which are left to roam at large in these wilds, though some of them have been trained to the saddle. Stopping at a spring which issued from a bed of quartzy sandstone, they found its temperature to be 96.8 degrees. To the height of 4,476 feet,

this mountain, like those in its vicinity, was covered with gramineous plants. The pastures became less rich in proportion to the elevation, and wherever the scattered rocks afforded a shade lichens and mosses occurred. The summit is 4,521 feet above the level of the sea. The view from it was extensive and highly picturesque; chains of mountains running from east to west enclosed longitudinal valleys, which were intersected at right angles by numberless ravines. The distant peninsula of Araya formed a dark streak on a glittering sea, and the more distant rocks of Cape Macanao rose amid the vast water like an immense rampart.

On the 14th of September they descended the Cocollar in the direction of San Antonio, where was also a mission. After passing over savannas strewed with blocks of limestone, succeeded by a dense forest, and two very steep ridges, they came to a beautiful valley about twenty miles in length, in which are situated the missions of San Antonio and Guanaguana. Stopping at the former only to open the barometer and take a few altitudes of the sun, they forded the rivers Colorado

and Guarapiche, and proceeding along a level and narrow road covered with thick mud, amid torrents of rain, reached in the evening the latter of these stations, where they were cordially received by the missionary. This village had existed only thirty years on the spot which it then occupied, having been transferred from a place more to the south.

Humboldt remarks that the facility with which the Indians remove their dwellings is astonishing, there being several small towns in South America which have twice changed their situation in less than half a century. These compulsory migrations are not unfrequently caused by the caprice of the ecclesiastic; and as the houses are constructed of clay, reeds and palm-leaves, a hamlet shifts its position like a camp.

The mission of San Antonio had a small church with two towers, built of brick, and ornamented with Doric columns, the wonder of the country; but that of Guanaguana possessed no place of worship, although a spacious house had been built for the padre, the terraced roof of which was ornamented with chimneys, like turrets, and which, he

informed the travelers, had been erected for no other purpose than to remind him of his native country. The Indians cultivate cotton. The machines by which they separate the cotton from the seeds are of very simple construction, consisting of wooden cylinders of very small diameter, made to revolve by a treadle. Maize is the article on which they principally depend for food; and when it happens to be destroyed by a protracted drought, they betake themselves to the surrounding forests, where they find subsistence in succulent plants, cabbage, palms, fern-roots, and the produce of various trees.

Proceeding towards the valley of the Caripe, the travelers passed a limestone ridge which separates it from that of Guanaguana; an undertaking which they found rather difficult, the path being in several parts only fourteen or fifteen inches broad, and the slope being covered with very slippery turf. When they had reached the summit an interesting spectacle presented itself to their view, consisting of the vast savannas of Maturim and Rio Tigre, the peaks of Turimiquiri, and a multitude of parallel hills resembling the waves of

a troubled ocean. Descending the height by a winding path, they entered a woody country, where the ground was covered by moss and a species of drosera. As they approached the convent of Caripe, the forests grew more dense, and the power of vegetation increased. The calcareous strata became thinner, forming graduated terraces, while the stone itself assumed a white color, with a smooth or imperfectly conchoidal fracture. This rock Humboldt considers as analagous to the jura deposits. He found the level of the valley of Caripe to be 1,279 feet higher than that of Guanaguana. Although the former is only separated from the latter by a narrow ridge, it affords a complete contrast to it, being deliciously cool and salubrious, while the other is remarkable for its great heat.

Arriving at the convent, the travelers were hospitably received by the monks. The Superior was absent; but having heard of their intention to visit this place, he had provided for them whatever could serve to render their abode agreeable. The convent was backed by an enormous wall of rocks of resplendent whiteness, covered with luxuriant

vegetation. The height of this monastery above the sea is about 2,650 feet. The mean temperature, inferred from that of the month of September, appears to be 65.3 degrees. This degree of heat is sufficient to develop the productions of the torrid zone, although much inferior to that of the plains of Cumana. Water exposed in vessels of porous clay cools during the night as low as 55.4 degrees. The mild climate and rarefied air of this place have been found highly favorable to the cultivation of coffee. In the garden of the community were many culinary vegetables, maize, the sugar cane, and five thousand coffee trees.

The greatest curiosity in this beautiful and salubrious district is a cavern inhabited by nocturnal birds, the fat of which is employed in the missions for dressing food. It is named the Cave of Guacharo, and is situated in a valley three leagues distant from the convent. On the 18th of September our travelers, accompanied by most of the monks and some Indians, set out for this cave, following for an hour and a half a narrow path leading across a fine plain covered with beautiful turf; then turning westward along a small river which

issues from the cave, they proceeded, during three-quarters of an hour, sometimes walking in the water, sometimes on a slippery and miry soil, between the torrent and a wall of rocks, until they arrived at the foot of the lofty mountain of Guacharo. Here the torrent ran in a deep ravine, and they went on under a projecting cliff, which prevented them from seeing the sky, until at the last turning they came suddenly upon the immense opening of the recess, which is eighty-five feet broad and seventy-seven feet high. The entrance is towards the south, and is formed in the vertical face of a rock, covered with trees of gigantic height, intermixed with numerous species of singular and beautiful plants, some of which hang in festoons over the vault. This luxuriant vegetation is not confined to the exterior of the cave, but appears even in the vestibule, where the travelers were astonished to see heliconias nineteen feet in height, palms and arborescent arums. They had advanced about four hundred and sixty feet before it became necessary to light their torches, when they heard from afar the hoarse screams of the birds. The guacharo is the size of a

domestic fowl, and has somewhat the appearance of a vulture, with a mouth like that of a goat-sucker. It forms a distinct genus in the order Passeres, differing from that just named in having a stronger beak, furnished with two denticulations, though in its manners it bears an affinity to it as well as to the alpine crow. Its plumage is dark blueish-gray, minutely streaked and spotted with deep brown; the head, wings and tail being marked with white spots bordered with black. The extent of the wings is three feet and a half. It lives on fruits, but quits the cave only in the evening. The shrill and piercing cries of these birds, assembled in multitudes, are said to form a harsh and disagreeable noise, somewhat resembling that of a rookery. The nests, which the guides showed by means of torches fastened to long poles, were placed in funnel-shaped holes in the roof. The noise increased as they advanced, the birds being frightened by the numerous lights.

About mid-summer every year the Indians, armed with poles, enter the cave and destroy the greater part of the nests. Several thousands of young birds are thus killed, and the

old ones hover around, uttering frightful cries. Those which are secured in this manner are opened on the spot, to obtain the fat which exists abundantly in their abdomen, and which is subsequently melted in clay vessels over fires of brushwood. This substance is semi-fluid, transparent, destitute of smell, and keeps above a year without becoming rancid. At the convent of Caripe it was used in the kitchen of the monks, and our travelers never found that it communicated any disagreeable smell or taste to the food. The guacharoes would have long ago been destroyed, had not the superstitious dread of the Indians prevented them from penetrating far into the cavern. It also appears that birds of the same species dwell in other inaccessible places in the neighborhood, and that the cave is repeopled by colonies from them. The hard and dry fruits which are found in the crops and gizzards of the young ones are considered as an excellent remedy against intermittent fevers, and regularly sent to Cariaco and other parts of the lower districts where such diseases prevail. The travelers followed the banks of the small river which issues from the cavern,

as far as the mounds of calcareous incrustations permitted them, and afterward descended into its bed.

The cave preserved the same direction, breadth and height, as at its entrance, to the distance of 1,554 feet. The natives inhabit its deep recesses, but the Indians who accompanied our travelers could hardly be persuaded to venture into it. Shooting at random in the dark, they obtained two specimens of the guacharo.

Having proceeded to a certain distance they came to a mass of stalactite, beyond which the cave became narrow, although it retained its original direction. Here the rivulet had deposited a blackish mould resembling that observed at Muggendorf, in Franconia; the seeds which the birds carry to their young spring up wherever they are dropped into it; and M. Humboldt and his feiends were surprised to find blanched stalks that had attained a height of two feet. As the missionaries were unable to persuade the Indians to advance farther, the party returued. The river, sparkling amid the foliage of the trees, seemed like a distant picture, to which the mouth of the

cave formed a frame. Having repose, they partook of a repast which the missionaries had prepared, and in due time returned to the convent.

On the 22d of September they departed, followed by four mules carrying their instruments and plants. The descent of the rugged chain of the Brigantine and Cocollar, which is about 4,400 feet in height, is exceedingly difficult. The missionaries have given the name of Purgatory to an extremely steep and slippery declivity at the base of a sandstone rock, in passing which, the mules, drawing their hind legs under their bodies, slide down at a venture. From this point they saw towards the left the great peak Guacharo, which presented a very picturesque appearance; and soon after entered a dense forest, through which they descended for seven hours in a kind of ravine, the path being formed of steps of from two to three feet high, over which the mules leaped like wild goats. The creoles have sufficient confidence in these animals to remain in their saddles during this dangerous passage, but our travelers preferred walking. The forest was exceedingly dense,

and consisted of trees of stupendous size. The guides pointed out some whose height exceeded 130 feet, while the diameter of many of the curucays and hymendas was more than three yards. Next to these, the plants which most attracted their notice were the dragon's blood, the purple juice of which flowed along the whitish bark, various species of palms, and arborescent ferns of large size; the old trunks of some of the latter were covered with a carbonaceous powder, having a metallic lustre, like graphite. As they descended the mountains the tree fern diminished, while the number of palms increased. Large-winged butterflies became more common, and everything showed that they were approaching the coast. The weather was cloudy, the heat oppressive, and the howling of the monkeys gave indication of a coming thunder-storm. These monkeys (the arguatoes) resemble a young bear, and are about three feet long from the top of the head to the root of the tail. The fur is tufty and reddish-brown, the face blackish-blue, with a bare and wrinkled skin, and the tail long and prehensile. While engaged in observing a troop of them crossing

the road upon the horizontal branches of the trees, the travelers met a company of naked Indians proceeding towards the mountains of Caripe. The men were armed with bows and arrows, and the women, heavily laden, brought up the rear. They marched in silence, with their eyes fixed on the ground. Continuing to descend amid scattered blocks, they unexpectedly found themselves at the end of the forest, when they entered a savanna, the verdure of which had been renewed by the winter rains. Here they had a splendid view of the Sierra del Guacharo, the northern declivity of which presented an almost perpendicular wall, exceeding 3,200 feet in height, and scantily covered with vegetation. The ground before them consisted of several level spaces lying above each other like vast steps. The mission of Vera Cruz, which is situated in the middle of it, they reached in the evening, and the next day continued their journey towards the Gulf of Cariaco. Proceeding on their way they entered another forest, and reached the station of Catuaro, situated in a very wild spot, where they lodged at the house of the priest. Their host was a doctor of

divinity, a little man of petulant vivacity, who talked continually of a lawsuit in which he was engaged with the Superior of his convent, and wished to know what Humboldt thought of free-will and the souls of animals. At this place they met with the corregidor of the district, an amiable person, who gave them three Indians to assist in cutting a way through the forest, the lianas and intertwining branches having obstructed the narrow lanes. (There are no wagon roads in this country, nothing but paths or trails.) The little missionary, however, insisted on accompanying them to Cariaco, and contrived to render the road extremely tedious by his observations on the necessity of the slave trade, the innate wickedness of the blacks, and the benefit which they derived from being reduced to bondage by the Christians. The road or path which they followed through the forest of Catuaro resembled that of the preceding day. The clay which filled the path and rendered it excessively slippery, was produced by layers of sandstone and slate-clay, which cross the calcareous strata. At length, after a fatigueing march, they reached the town of Cariaco,

on the coast, where they found a great part of the inhabitants confined to their beds with intermittent fever. The low situation of the place, as well as of the surrounding district, the great heat and moisture, and the stagnant marshes generated during the rainy season, are supposed to be the causes of this disease, which often assumes a malignant character, and is accompanied with dysentery. Men of color, and especially creole negroes, resist the influence of the climate much better than any other race.

HUMBOLDT'S ACCOUNT OF THE INDIANS OF EQUINOCTIAL AMERICA.

The north-eastern part of Equinoctial America, Terra Firma, and the shores of the Orinoco, resembles, in the multiplicity of the tribes by which they are inhabited, the defiles of Caucasus, the mountains of Hindookaho, and the northern extremity of Asia, beyond the Tungooses and the Tartars of the mouth of the Lena. The barbarism which prevails in these various regions is perhaps less owing to an original absence of civilization than to the effects of a long debasement; and

if everything connected with the first population of a continent were known, we should probably find that savages are merely tribes banished from society and driven into the forests. At the commencement of the conquest of America the natives were collected into large bodies only on the ridge of the Cordilleras and the coast opposite to Asia. They were wandering tribes previous to the war, and only separated by differences of language and manners.

In New Andalusia, Cumana and New Barcelona, the aborigines still form fully one-half of the scanty population. Their number may be about 60,000, of which 24,000 inhabit the first of these provinces. This amount appears large when we refer to the hunting tribes of North America, but seems the reverse when we look to those districts of New Spain where agriculture has been followed for more than eight centuries. Thus the intendancy of Oaxaca, which forms part of the old Mexican empire, and which is one-third smaller than the two provinces of Cumana and Barcelona, contains more than 400,000 of the original race. The Indians of Cumana do not all live

assembled in the missions, some being found dispersed in the neighborhood of towns along the coasts.

The stations of the Arragonese Capuchins contain 15,000, almost all of the Chayma tribe. The villages, however, are less crowded than in the provinces of Barcelona, their indigenous population being only between five and six hundred; whereas, more to the west, in the establishments of the Franciscans of Peritoo, there are towns of 2,000 or 3,000 inhabitants. Besides the 60,000 natives of the provinces of Cumana and Barcelona, there are some thousands of Guaraounoes who have preserved their independence in the island at the mouth of the Orinoco. Excepting a few families there are no wild Indians in New Andalusia.

The term wild or savage, Humboldt says he uses with regret, because it implies a difference of cultivation which does not always exist between the reduced or civilized Indian, living in the missions, and the free or independent Indian. In the forests of South America there are tribes which dwell in villages, rear plantains, cassava and cotton, and

are scarcely more barbarous than those in the religious establishments who have been taught to make the sign of the cross.

It is an error to consider all the free natives as hunters; for agriculture existed on the continent long before the arrival of the Europeans, and still exists between the Orinoco and Amazon, in districts to which they have never penetrated. The system of the missions has produced an attachment to landed property, a fixed residence, and a taste for a quiet life; but the baptized Indian is often as little a Christian as his heathen brother is an idolator, both discovering a marked indifference for religious opinions, and a tendency to worship nature.

There is no reason to believe that in the Spanish colonies the number of Indians has diminished since the conquest. There are still more than six millions of the copper-colored race in both Americas; and although tribes and languages have been destroyed or blended in those colonies, the natives have, in fact, continued to increase in South America. In the temperate zone, the contest of Europeans with the indigenous population becomes fatal

to the latter; but in South America the result is different, and there they do not dread the approach of the whites. In the former case a vast extent of country is required by the Indians, because they live by hunting; but in the latter, a small piece of ground will suffice to afford subsistence for a family. In these provinces the Europeans advance slowly, and the religious orders have founded establishments between the regions inhabited by them and those possessed by the independent Indians.

The missions have, no doubt, encroached on the liberty of the natives, but they have generally been favorable to the increase of the population. As the preachers advance into the interior, the planters invade their territory, whites and the casts of mixed breed settle among the Indians, the missions become Spanish villages, and finally the old inhabitants lose their original manners and language. In this way civilization advances from the coasts towards the centre of the continent.

Although the Indians attached to the missions are all agriculturists, cultivate the same plants, build their huts in the same manner,

and lead the same kind of life, yet the shades by which the several tribes are distinguished remain unchanged. There are few of these villages in which the families do not belong to different tribes, and speak different languages. The missionaries have, indeed, prohibited the use of various practices and ceremonies, and have destroyed many superstitions; but they have not been able to alter the essential character common to all the American races. The instructed Indian, more secure of subsistence than the untamed native, and less exposed to the fury of hostile neighbors or of the elements, leads a more monotonous life, possesses the mildness of character which arises from the love of repose, and assumes a sedate and mysterious air; but the sphere of his ideas has received little enlargement, and the expression of melancholy which his countenance exhibits is merely the result of indolence. The Chaymas, of whom more than fifteen thousand inhabit the Spanish villages, are generally of a low stature, their ordinary height being about five feet two inches; but their figures are broad and muscular; the color of the skin is a dull brown,

inclining to red; the expression of the countenance is sedate and somewhat gloomy; the forehead is small and retiring; the eyes sunk, very long and black, but not so small or oblique as in the Mongolian race; the eyebrows slender, nearly straight, and black or dark brown, and the eyelids furnished with very long lashes; the cheek bones are usually high, the hair straight, the beard almost entirely wanting, as in the same people, from whom they differ essentially in having the nose pretty long. The mouth wide, the lips broad but not prominent, the chin extremely short and round, and the jaws remarkable for their strength. The teeth are white and sound, the toothache being a disease with which they are seldom afflicted. The hands are small and slender, while the feet are large, and the toes possessed of an extraordinary mobility. As they live in a very warm country they are excessively averse to clothing. In spite of the remonstrances of the monks, men and women remain naked while within their houses; when they go out they wear only a kind of cotton gown scarcely reaching to the knees. The dress of the men has sleeves, while that of

the women and boys has none; the arms, shoulders and upper part of the breast being uncovered. Till the age of nine the girls are allowed to go to church naked. The missionaries complain that the feeling of modesty is very little known to the younger of the sex.

The Chayma Indians lead a very regular and uniform life. They go to to bed at seven and rise at half-past four. The inside of their huts is kept very clean, and their hammocks, utensils and weapons are arranged in the greatest order. They bathe every day, and being generally naked, are thus exempted from the filth principally caused by clothing. Besides their cabin in the village, they usually have a smaller one, covered with palm or plantain leaves, in some solitary place in the woods, to which they retire as often as they can; and so strong is the desire among them of enjoying the pleasures of savage life, that the children sometimes wander entire days in the forest. In fact the towns are often almost wholly deserted. As in all semi-barbarous nations, the women are subject to privation and suffering, the hardest labor falling to their share.

The Indians learn Spanish with extreme difficulty; and even when they perfectly understand the meaning of the words, are unable to express the most simple ideas in that language without embarrassment. They seem to have little capacity for comprehending anything belonging to numbers; the more intelligent counting in Spanish, with the appearance of great effort, only as far as thirty or perhaps fifty, while in their own tongue they cannot proceed beyond five or six.

Santa Fe de Bogota, the capital of New Grenada, South America, is situated in a beautiful valley surrounded by lofty mountains, and which would appear to have been at a former period the bed of a great lake. This elevated basin or valley on which the metropolis is built, is 8,727 feet above the level of the sea. The river of Funzas, usually called Rio de Bogota, which drains the valley, has forced its way through the mountain to the south-west, where it rushes from the basin by a narrow outlet into a crevice which descends towards the bed of the Rio Magdalena. Respecting this ravine through which this river descends, there was among the old

inhabitants a tradition disseminated among the people, who were barbarians living without religion, laws, or arts. An old man, on a certain occasion, suddenly appeared among them, of a race unlike that of the natives, and having a long bushy beard. He instructed them in the arts; but he brought with him a very malignant, although very beautiful woman, who thwarted all his benevolent enterprises. By her magical power she swelled the current of the Funza, and inundated the valley, so that most of the inhabitants perished; a few only found refuge in the mountains. The aged visitor then drove his consort from the earth and she became the moon. He next broke the rocks that enclosed the valley on the Tequandam side, and by this means drained off the waters; then he introduced the worship of the sun, appointed two chiefs, and finally withdrew to a valley, where he lived in the exercise of the most austere penitence during 2,000 years.

The cataract of Tequendama presents an assemblage of all that is picturesque. The river, a little above it, is 144 feet in breadth, but at the crevice narrows to a width of

twelve yards. The height of the fall, which forms a double bound, is 574 feet, and the column of vapor that rises from it is visible from Santa Fe at the distance of seventeen miles. In the same region is the natural bridges of Icononzo, formed by masses of rocks lying across a ravine of immense profundity, the valleys of the Cordilleras are generally crevices, the depth of which is often so great, that were Vesuvius seated in them its summit would not exceed that of the nearest mountains. One of these, namely, that of Icononzoor Pandi, is peculiarly remarkable for the singular form of its rocks, the naked tops of which present the most picturesque contrast with the tufts of trees and shrubs which cover the edges of the gulf. A torrent, named the Summa Paz, forms two beautiful cascades where it enters the chasm, and where it again escapes from it. A natural arch forty-seven and one-half feet in length and thirty-nine in breadth, stretches across the fissure at a height of 318 feet above the stream. Sixty-four feet below this bridge is a second bridge composed of three enormous masses of rock, which have fallen so as to support each other. In the

middle of it is a hole through which the bottom of the cleft is seen. The torrent, viewed from this place, seemed to flow through a dark cavern, whence arose a doleful sound, emitted by the nocturnal birds that haunt the abyss, thousands of which are seen flying over the surface of the water, supposed by Humboldt, from their appearance, to be goat-suckers.

ANDES AND ROCKY MOUNTAINS.

On the island of Cape Horn is an immense black rock which rises like a mountain to the height of 3,500 feet above the level of the sea, pointing northward. This rock, although separated from the main land by the Straits of Magellan, may be called the south end or the beginning of the Andes Mountains in South America. These mountains, as they extend northward through Patagonia, rise abruptly from the Pacific coast, and fall back from the ocean from 60 to 100 miles eastward, and in some places spreading out in width to the distance of 400 miles toward the Atlantic ocean, and extending northward under different names and ranges, through South America, Central America, Mexico, United States and the British Possessions in North America, a distance of 9,000 miles. This whole range is known under the names of Andes and Rocky Mountains, and the whole length and breadth of this range are said to be a volcanic region, the most extensive on the globe.

PYRAMIDS OF EGYPT.

The building of the Pyramids of Egypt is still a wonder. They were built between two and three thousand years before the Christian era. These pyramids, one of the old seven wonders of the world, are seventy in number. The three principal ones are situated about six miles from Cairo. The largest, entitled the Pyramid of Cheops, covers eleven acres of ground. It is 480 feet high. Herodotus states that 100,000 men were employed for forty years in constructing this pyramid. It is built of vast blocks of stone, brought from quarries many miles distant.

Whenever an Egyptian king began his reign he began to construct a pyramidical tomb, not very large at first, in order to secure its being finished before his death. Once built, new layers of stone were constantly put upon it on all sides during his reign, and thus the longer the reign the larger the pyramid. The difference in the size of these pyramids is thus accounted for. Always in the centre of

the pyramid a small room was reserved, to which access could be obtained from a secret gallery from without; and in this sepulchral nook there is a coffin of red granite, in which human remains were once deposited.

The outer casing of each pyramid was of polished black marble, set in a cement which is as hard as the stone itself. This casing has fallen from the sides of the Pyramid of Cheops, and it is a favorite, but very fatigueing feat for tourists to climb up to the top, which is a flat table of stone, thirty-two feet square. The three most noted pyramids are described by Herodotus, and which are still regarded as the finest monuments of this class that are to be seen in any part of the world. It is noticed by every author who, from personal observation, has described these wonderful works of art, that the sense of sight is much deceived in the first attempt to appreciate their wonderful magnitude.

They are situated on a platform of rock about a hundred and fifty feet above the level of the surrounding desert, a circumstance which at once contributes to their being well seen, and also to the discrepancy that still pre-

vails among intelligent travelers as to their actual height. It is not until the eyes become accustomed to the magnitude of the outline of the stupendous pile of masonry, that they could form an estimate of their real dimensions; after which you would hardly be able to convince yourselves that such enormous structures were really the work of human hands.

The largest pyramid stands on an elevation free all around, on which account the accumulation of drifting sand, so common in Egypt, and has covered a good part of that country, is less than might be expected. It has, however, suffered much from human violence, immense heaps of broken stones having fallen down on each side, which form a high mound towards the middle of the base. The corners are pretty clear, where the foundation is readily discovered, particularly at the north-west angle; but it is impossible to see straight along the line of the base, on account of these heaps of rubbish. Hence arises the difficulty of making an exact measurement, and the frequent disagreement of the result; it being impracticable, without removing the sand and fallen

stones, to run a straight line all the way in contact with the building.

THE ENTRANCE INTO THE PYRAMID.

This entrance is on the north side and is nearly in the centre, about equal distance from each angle; being at the same time elevated about thirty feet above the base, probably that it might be more difficult for a conqueror to discover it, and less liable to be blocked up with the drifting sand. The ascent to it is over a heap of stones and rubbish, that have either fallen from the pyramid or been forced out and thrown down in the various efforts made at successive periods to find a passage into the interior. This heap at present rises considerably above the entrance, which is a small orifice not more than three feet and a half square; it is lined above and below, and on either side, with broad flat rocks of red granite, smooth and highly polished.

The flags in the bottom of the passage are formed with alternate depressions and elevations, in order to afford a firm footing to the person descending; but this, it is presumed,

is a modern operation because the depressions are not smooth and polished like the rest of the stones.

After advancing nearly a hundred feet into the entrance, which slopes downward at an angle of about twenty-six degrees, the explorer finds an opening on the right hand, which conducts him up an inclined plane to the queen's chamber, as travelers have agreed to call it, an apartment seventeen feet long, fourteen feet wide and twelve feet high to the point on which the roof is suspended. Ascending a similar passage, but somewhat steeper than the first, he perceives another chamber of larger dimensions, being thirty-seven feet two inches long, seventeen feet two inches wide and about twenty feet high. This is denominated the king's chamber; but upon better authority, we can discover that the caprice of tourists have already converted it into a local tradition. Its magnificence, however, entitles it in some degree to the distinction which it has obtained. It is lined all around with large slabs of highly-polished granite, reaching from the floor to the ceiling; this last being formed of nine immense flags which stretch from wall

to wall. Towards the west end of the room stands the sarcophagus, which likewise consists of red granite highly polished, but without either sculpture or hieroglyphics. Its length is seven feet six inches, while the depth and width are each three feet three inches. There is no lid, nor was there anything found in it except a few fragments of stone with which the chamber is decorated. As this room does not reach beyond the centre of the pyramid, Dr. Richardson suggested the very probable opinion that there are other passages leading to other chambers in communication with it; the entrance to which would, it is very likely, be found by removing some of the granite slabs which serve as wainscoting to the walls.

To present to the eye a uniform surface in the interior of an apartment was one of the devices usually employed by an architect in old times when he wished to conceal from an ordinary observer the approach to a secret retreat, reserving to himself and his employer the knowledge of the particular stone which covered the important orifice, as well as the means of obtaining a ready access.

A third chamber, still higher in the body of the pyramid than either of the two just mentioned, was discovered by Mr. Davison, who about seventy years ago was the British Consul at Cairo. Having on one of his visits observed a hole in the top of the gallery, he resolved to ascertain the object of it, and whether it led to any apartment which had not yet been described. For this purpose he made seven short ladders in such a manner as to fasten one to another by means of four wooden pins, the whole set, when joined, being about twenty-six feet in length. When all the parts were put together, the ladder entered enough into the hole to prevent it from sliding on the side of the gallery. He then mounted and found a passage two feet four inches square, which turned immediately to the right. He entered a little way, with his face on the ground, but was obliged to retire on account of the passage being in a great measure choked with dust and bats' dung, which in some places was near a foot deep. He first thought of clearing a path by throwing the dirt down into the gallery; but, foreseeing that this would be a work of some

time, he determined to make another effort to enter, which was attended with more success than the first. He was able to creep in, though with much difficulty, not only on account of the lowness of the passage, but likewise the quantity of dust which he raised. When he had advanced a little way he discovered what he supposed to be the end of the approach. His surprise was great to find to the right a straight passage into a long, broad, but low place, which he knew, as well by the length as the direction of the entry he had come in at, to be immediately above the large room. The stones of this passage are uneven, being of unequal thickness. The room is four feet longer than the one below; in the latter you see only seven stones, and a half of one on each side of them; but in that above, the nine are entire, the two halves resting on the wall at each end. The breadth is equal with that of the room below. The covering of this, as of the other, is of beautiful granite, but it is composed of eight stones instead of nine, the number in the room below. At this stage of the investigation, Mr. Davison was joined by some of his attendants, who being

a great deal troubled with the dust and want of air, soon retired. At length, after having measured and examined every part of the chamber, he also descended by the ladder, satisfied that no more could be accomplished without the accession of greater strength and means.

The same room was entered and explored a few years ago by Mr. Caviglia, to whose enterprising spirit the antiquaries of Egypt are under great obligations, but without adding anything to our knowledge of its structure or intention. He remarks, that the sides of the chamber were coated with red granite of the finest polish; and he ascertained that the uneveness of the floor was occasioned by its being formed of the individual blocks of syenite which constituted the roof of the chamber below; hence they must be wedged in on the principal of the arch. The bats' dung, which in the time of Mr. Davison was a foot in depth, had now increased to a foot and a half.

But it is extremely doubtful, even after laborious endeavors, whether we have yet made farther progress in dissecting the struc-

ture of the pyramid than was attained by the Greeks and Romans two thousand years ago, for it is worthy of notice that every recess that has been explored in modern times bears marks of having been examined by former adventurers. We find, besides, that the narrow entrance into the great pyramid was known to Strabo, which he tells us had a stone placed at the mouth of it to be removed at pleasure. The same author, likewise, as well as Herodotus, was acquainted with the subterranean chambers, and Pliny has left a description of the well in the pyramid. It is true that they declined to enter into many particulars which could hardly have failed to have met their observation, an omission which we are justified, at least in the case of Herodotus, in attributing to certain superstitious notions of their sanctity and mysterious uses. The account given by Mr. Davison of his descent into the well above alluded to, is so interesting that we cannot withhold from the reader an outline of his proceedings. Conceiving it to be very deep, he provided himself with a large quantity of rope, one end of which he tied around his waist; and letting

down a lantern attached to a small cord, he resolutely prepared to follow. With no small difficulty he prevailed on two of his servants and three Arabs to hold the line, the latter assuring him that there were ghosts below, and that he could never hope to return. Taking with him a few sheets of paper, a compass, a measure, and another lighted candle, he commenced the descent, and soon reached the bottom of the first well or shaft. Here he found, on the south side, at the distance of about eight feet from the place where he landed, a second opening, which descended perpendicularly to the depth of five feet only; and at four feet ten inches from the bottom of this discovered a third shaft, the mouth of which was nearly blocked up with a large stone, leaving an opening barely sufficient to allow a man to pass. Here he dropped down his lantern, not only with a view of ascertaining to what depth he was about to proceed, but also to determine whether the air was pernicious or otherwise. The shaft, however, was so tortuous that the candle became invisible; but the consul was not to be discouraged, as nothing less than a journey to the bottom

would satisfy his eager curiosity. His main difficulty arose from the superstitious dread of the Arabs, who could hardly be prevailed upon to go down and hold the rope. After many prayers and threats, and promises of money, and of all the treasures which might be found in the well, the avarice of one man so far overcame his terror that he ventured to descend, though on reaching the bottom he stared about him, pale and trembling, and appeared more like a spectre than a human being.

Mr. Davison now pushed forward with the rope around his body, being convinced, from the distant view of the lantern which he had let down, that this well was somewhat deeper than the first. Having proceeded a little farther than half way to the spot where the candle had rested, he came to a grotto about fifteen feet long, four or five wide, and nearly the height of a man. From this place the third shaft or well was sloping; and by throwing down a stone he ascertained it to be of much greater depth than the others. But, still resolved to persevere, he pushed the lantern a little before him, and set out afresh on

his journey, calling to the Arab to loosen the rope gently, and availing himself of little holes made in the rock, obviously with the purpose of aiding a descent. At length, the shaft beginning to turn a little more to the perpendicular, he arrived speedily at the bottom, where he found all further passage precluded by a large accumulation of sand or rubbish.

Having reached this point, our adventurer began to reflect on two circumstances which had not before occurred to him, either of which would have agitated weaker nerves. The first was that the multiude of bats which he had disturbed might put out his candle; and the second, that the immense stone on the mouth of the pit might slip down and close the passage forever. On looking about the bottom he found a rope ladder, which, though it had lain there sixteen years, was as fresh and strong as if perfectly new. It had been used, as is conjectured, by Mr. Wood, the author of a book on the ruins of Balbec and Palmyra, to assist his progress downwards; but he, it is concluded, must have stopped at the grotto.

When Mr. Davison, on his return, had reached the bottom of the first shaft, the candles fell and went out; upon which the poor Arab thought himself lost. He laid hold of the rope as his master was about to ascend, declaring that he would rather have his brains blown out than to be left alone there with the devil. I therefore permitted him to go before; and though it was much more difficult to ascend than to descend, I know not how it was, but he scrambled up a hundred times more quickly than he had come down. The depth of the first shaft was twenty-two feet; of the second, twenty-nine; and of the third, ninety-nine; which, with the five feet between the first and second, makes the whole descent one hundred and fifty-five feet.

It is somewhat remarkable that the dimensions assigned to the well by Pliny were eighty-six cubits, an approximation to the truth, which must remove all doubt from the mind of every candid reader, that the honor of detecting the intricacies of the great pyramid was not reserved for the moderns. The Romans appear to have taken a considerable interest in the architectural antiquities of

Egypt, the names of their favorite princes being inscribed on the monuments; and hence, it might have been inferred that this, one of the greatest works of the ancient world, would not fail to attract their attention.

The latest and most complete survey, however, made of the hidden caverns of the Pyramid of Cheops, is that accomplished by Mr. Caviglia, the spirited foreigner already mentioned. In his first attempt to sound the depth of the celebrated well he descended as far as Mr. Davison had done, and with nearly similar results. But he was by no means satisfied with the issue of his labor. Observing that the ground under his feet gave a hollow sound, he suspected that there must be some concealed outlet. He accordingly determined to resume operations; and with this view he hired several Arabs, whom he employed in drawing up the rubbish from the bottom with baskets and cords. In a short time, however, owing to the extreme reluctance of these people to work, he was compelled to suspend his undertaking until an order from the Kaiyabey was procured, which had the effect of subduing their indolence, and to a certain

degree, of removing their prejudices. It is not, therefore, surprising, that the natives should have manifested reluctance to labor in circumstances so appalling; being confined in a place where, owing to the impurity of the atmosphere, no light would burn longer than half an hour, and where the heat was so intense as to threaten suffocation. At length, in fact, it became so intolerable that one Arab was carried up nearly dead, and several others, on their ascending to the surface, fainted away; so that, at last, in defiance of the command laid upon them, they almost entirely abandoned the task, declaring that they were willing to work but not to die for him.

Thus opposed and disappointed, Mr. Caviglia next turned his attention to the clearing of the principal entry or passage into the pyramid, which, from time immemorial, had been so blocked up as to oblige those who ventured within its orifice to creep on their hands and knees. His chief object in this undertaking was to improve the ventilation of the interior, a purpose for which he labored; he made the unexpected discovery that the main passage leading from the main entry did not terminate

in the manner asserted by Maillet, and believed by all his successors. On the contrary, having removed several large masses of calcareous stone and granite, apparently placed there to obstruct all further progress, he found that it still continued in the same inclined plane downwards, was of the same dimensions, and had its sides worked with the same care as in the portion above, though filled up nearly to the top with earth and fragments of rock. After clearing it out to the length of a hundred and fifty feet, the air became again so impure, and the heat so suffocating, that he had once more the same difficulties to encounter with regard to the Arabs. Even his own health was at this time visibly impaired, and he was attacked with spitting of blood; but nothing could induce him to desist from his interesting researches.

After the lapse of the third month from the time at which he began his toils, he had excavated as far as two hundred feet in the new passage without anything particular occurring, when, shortly afterward, a door on the right hand was discovered, from which, in the course of a few hours, a strong smell of

sulphur was perceived to issue. Mr. Caviglia, having now recollected that when at the bottom of the well, in his first enterprise, he had burned some sulphur for the purpose of purifying the air, conceived it probable that this doorway might communicate with it, an idea which, in a little time, he had the pleasure of seeing realized, by discovering that it opened at once upon the bottom of the well, where he found the baskets, cords and other implements which had been left there on his recent attempt at a farther excavation. This discovery was so far valuable as it afforded a complete circulation of air along the whole passage and up the shaft of the well, and thereby obviated all danger for the future, arising from the noxious condition of the atmosphere.

But the passage did not terminate at the doorway which opened at the bottom of the well; continuing to the distance of twenty-three feet beyond it, in the same angle of inclination, it became narrower, and took a horizontal direction for about twenty-eight feet farther, where it opened into a spacious apartment immediately under the central point of the pyramid. This new chamber is sixty-six

feet long by twenty-seven broad, with flat roof; and, when first entered, was found nearly filled with large stones and rubbish, which Mr. Caviglia succeeded in removing. The platform of the floor, which is dug out of the rock, is irregular, nearly one-half of the length from the east end being level and about fifteen feet from the ceiling; while in the middle it descends five feet lower, in which there is a hollow space, bearing all the appearance of the commencement of a well or shaft. From this point it rises to the western end, so that at the extremity there is scarcely room between the floor and the roof for a man to stand upright, the whole chamber having the appearance of an unfinished excavation. Mr. Salt, however, is disposed to think, after a careful comparison of it with other subterranean apartments which have been disfigured by the combined effects of time and the rude hands of curious visitors, that it may once have been highly wrought, and used, perhaps, for the performance of solemn and sacred mysteries.

Some Roman characters, rudely formed, had been marked with the flame of a candle on a rock, part of which having mouldered away,

rendered the words illegible. The same gentleman had flattered himself that this chamber would turn out to be the one described by Herodotus, as containing the tomb of Cheops, which was insulated by a stream drawn from the Nile; but the want of an inlet for the sacred fluid, and the elevation of the floor thirty feet above the level of the river at its highest inundation, put an end to this delusive opinion.

From an expression of Strabo, however, purporting that the passage from the entrance leads directly down to the chamber which contains the sarcophagus, he thinks, and perhaps justly, that this apartment was the only one known to the Greek geographer.

On the south side of this spacious excavation there is a passage just wide and high enough for a man to creep along on his hands and knees, continuing horizontally in the rock for fifty-five feet; but there it abruptly terminates. Another opening at the east end of the chamber commences with a kind of arch, and runs about forty feet into the solid rock of the pyramid. A third passage is mentioned, but so obscurely that we cannot ascer-

tain either its direction or dimensions. It is not, however, to be imagined that these passages had no object, or that they originally terminated at the point where the curiosity of modern travelers meets a check from the accumulation of rubbish, or, perhaps, from the intervention of a regular portcullis, such as Belzoni encountered in the second pyramid. Dr. Richardson, indeed, insinuates that the avenues in question have not been actually explored by several writers who have thought proper to describe them, a charge which, we are satisfied, does not apply to Caviglia, whose exertions were only limited by the utmost bounds of human energy and perseverance.

Before we proceed to some more general observations on the history and comparative magnitude of the pyramids, we shall present to the reader the interior of that which bears the name of Cephrenes.

As Herodotus, whose fidelity has been generally approved by the investigation of more recent times, gives assurance that there were no chambers in this edifice, a long time had passed without any attempt being made to penetrate its outer walls; in fact, such an

undertaking was regarded as equally romantic and impracticable. The French philosophers who accompanied the invading army led by Bonapart, made several endeavors to find an entrance, but, perceiving no trace in the building which could encourage the belief that it had ever been perforated, they left it in despair. The resolution of Belzoni, however, a private, unassisted individual, achieved a conquest over the mystery of ancient art, which the power and ingenuity of a great nation had relinquished as beyond the reach of human means. His success in detecting the sepulchral labyrinths of Thebes, inflamed him at once with the desire and confidence of discovering a passage into the secret chamber of Cephrenes, the reputed founder of the second pyramid. His first attempt was not attended with any adequate degree of success, while the labor and expense which it entailed upon him were so great as would have cooled the ardor of a less zealous antiquary. He began by forcing a passage, which he was soon obliged to abandon, as equally hopeless to himself and dangerous to the persons employed. But this disappointment only increased his

desire to accomplish an object on which he had staked his happiness as well as his reputation. Observing minutely the exterior of the great pyramid, he satisfied himself that the passage was not placed exactly in the middle of the building, but that it ran in a straight line to the eastern side of what is called the king's chamber; which being in the centre of the pyramid, he conjectured that the entrance must be as far from the middle of the face as is the distance from the centre of the chamber to the east end of it. Having made this clear and simple observation, he concluded that if there were any chambers in the second pyramid, the orifice could not be at the spot where he had begun his excavation, but calculating by the position of the passage in the first, nearly thirty feet farther east. Encouraged by these new views, he returned to his task, and was immediately delighted to observe that at the very place where he intended to commence operations there was a hollow on the surface of the building. Any traveler, says he, who shall hereafter visit the pyramids may plainly perceive this concavity above the true entrance.

Summoning his Arabs, he forthwith resumed his toils; and so correct was his measurement that he did not deviate more than two feet from the mouth of the passage which was to admit him into the recesses of this vast edifice. The native workmen were indeed as skeptical as ever, entertaining not the slightest expectation that any approach would ever be discovered, and occasionally muttering their opinion of him in the expressive term *magnoon*, which, in their language, denotes madman or fool. After clearing away a great deal of rubbish, and cutting through massy stones, he had the satisfaction of seeing the edge of a block of granite, the material used for casing the passage in the Pyramid of Cheops, inclining downward at the same angle as in the latter building, and pointing towards the centre.

On the following day three large slabs were discovered, one on each side, and the third on the top, indicating very distinctly that the object of his search was now about to be realized. In a few hours, accordingly, the right entrance into the pyramid was opened, proving to be a passage four feet high, and three feet

six inches wide, formed of granite, and descending a hundred and four feet towards the centre, at an angle of twenty-six degrees. Nearly all this passage was filled with large stones which had fallen from the upper part, and, as the floor slopes downward, they had slid on till some larger than the rest stopped the way. The next portion of his task was to remove this rubbish, which had extended even to the entrance of the chamber. At length he reached a portcullis, which, being a fixed block of stone, at first sight appeared to obstruct all further progress into the interior. It stared him in the face, said Mr. Belzoni, and said *ne plus ultra*, putting an end, as he thought, to all his projects; for it made a close joint on either side, and on the top it seemed as firm as the rock itself which formed the passage. On a close inspection, however, he perceived that at the bottom it was raised about eight inches from the lower part of the groove which was cut beneath to receive it; and he found by this circumstance that the large slab before him was nothing more than a barrier of granite, one foot three inches thick. Having observed a small aperture at

the top, he thrust a straw into it upwards of three feet, a discovery which convinced him that there was a vacuum prepared to receive the portcullis. The raising of it, indeed, was a work of small difficulty. As soon, however, as it was elevated high enough for a man to pass, an Arab entered with a candle, and announced that the place within was very fine. A little more room enabled our adventurer to squeeze his person through, when he exclaims: After thirty days I had the pleasure of finding myself in the way to the central chamber of one of the two great pyramids of Egypt, which have long been the admiration of beholders. As his main object was to reach the centre of the building, he advanced in that direction, along a passage cut out of the solid rock, six feet in height, and six feet six inches broad. At length he reached the door at the centre of a large chamber. I walked slowly two or three paces, and then stood still to contemplate the place where I was. Whatever it might be, I certainly considered myself in the centre of that pyramid, which from time immemorial had been the subject of the obscure conjectures of many hundred travelers,

both ancient and modern. My torch, formed of a few wax candles, gave but a faint light; I could, however, clearly distinguish the principal objects. I naturally turned my eyes to the west end of the chamber, looking for the sarcophagus, which I strongly expected to see in the same situation as that in the first pyramid; but I was disappointed when I saw nothing there. The chamber has a pointed or sloping ceiling, and many of the stones had been removed from their places, evidently by some one in search of treasure. On my advancing towards the west end I was agreeably surprised to find that there was a sarcophagus buried on a level with the floor.

Upon examining more minutely the chamber into which he had entered, he found it to be forty-six feet in length, sixteen feet three inches wide, and twenty-three feet six inches high. It is hewn out of the solid rock from the floor to the roof, which last is composed of large slabs of calcareous stone, meeting in the centre at an angle corresponding to that of the pyramid itself.

The sarcophagus is eight feet long, three feet six inches wide, and two feet three inches

deep in the inside. It is surrounded by large blocks of granite, apparently to prevent its removal, which could not be effected without great labor. The lid had been drawn to one side, so that the receptacle, be it fount or grave, was half open. It is manufactured of the very finest granite; but like the other in the Pyramid of Cheops it presents not a single hieroglyphic. Inspecting the inside solely with the view of finding some inscription which would throw light on the history and intention of this mighty edifice, he had not at first observed that there were bones mixed with the sand and gravel which it contained. These fragments of an animal body being afterwards sent to London, were ascertained to belong to the bovine species, and have been very generally supposed to be the remains of a sacred bull, an object of veneration among the ancient Egyptians.

On the sides of the chamber, which were carefully examined, Mr. Belzoni observed many scrawls executed with charcoal; all of which, however, were in a character quite unknown to him, and already become so faint that they were in some places nearly illegible,

and rubbed off on the slightest touch. On the wall at the west end of the chamber he perceived an inscription which has been translated as follows:

"The Master Mohammed Ahmed lapicide has opened them; and the Master Othman attended this (opening,) and the King Ali Mohammed, from the beginning to the closing up."

Mr. Belzoni admits that the letters were far from being distinct. The transcriber was a Copt, whom he induced to go from Cairo for the purpose, not having sufficient confidence in his own pen. He adds, however, that not being satisfied with his protestations of accuracy, though the inscription was copied under his own eyes, he invited other persons who were esteemed the best Arabic scholars in the country to lend their aid, and particularly to compare the transcript with the original on the wall. They found it all perfectly correct and intelligible, except the concluding word, which was acknowleged to be obscure; but, says he, if it be considered how much that word resembles the right one, we shall find a good sense and the whole inscrip-

tion made out. The circumstance, too, supposed to be here recorded, that the pyramid was closed up after having been opened by the agents of King Ali Mohammed, correspond exactly to the facts in the case, and affords a strong corroboration of the conjectural emendation proposed by the translator. It is remarkable that in this pyramid, as well as in the larger one, there is a pit or shaft which descends to a lower part of the building.

At the bottom of this opening there were so many stones as to nearly choke up its entrance; but after removing these, Mr. Belzoni found the passage running toward the north, as formerly, at an angle of twenty-six degrees. It continued in this direction, and with the same slope downwards, forty-eight feet and a half, where it joined a horizontal passage fifty-five feet in length, eleven feet long, and six deep. On the left, opposite to it is another entry twenty-two feet in length, with a descent of twenty-six degrees towards the west. Before he proceeded any farther northwards, he went down this passage, where he found a chamber thirty-two feet long, nine feet nine

inches wide, and eight feet six inches in height. This apartment contains many small blocks of stone, some not more than two feet in length. It has a pointed roof like those before mentioned, though it is cut out of the solid rock. On the walls and ceiling are some unknown inscriptions similar to those in the upper chamber.

Reascending to the horizontal passage, he discovered at the end of it a portcullis, which must have originally possessed the same construction as the one already described; but the plate of granite which had served as a door was taken down, and it is still to be seen under the rubbish which encumbers the approach. Beyond this point he entered into a lane which runs forty-eight feet in a direction parallel to the one above, and, in fact, appears to issue from the pyramid near its base. If this supposition be well founded, it will follow that the monument of Cephrenes has two entrances, an inference, we presume, which might be extended to that of Cheops, where there are several passages without any outlet hitherto discovered. The immense mass of the larger edifice has all along prevented such

a minute examination of its lower parts as might have enabled the scientific antiquary to connect the internal structure with the general plan and uses of the building. Hence it is extremely probable that apertures will be found in all the four sides conducting to the centre, at different angles of inclination, and establishing a communication among the various chambers which the pyramids contain.

It is a theme of admiration so justly due to the perseverance of Mr. Belzoni, that it is truly observed by Mr. Salt that the opening of this pyramid had long been considered an object of so hopeless a nature that it is difficult to conceive how any person could be found sanguine enough to make the attempt; and even after the laborious discovery of the forced entrance, it required great resolution and confidence in his own views to induce him to continue the operation, when it became evident that the enterprise of his predecessors, possessed of greater means, had completely failed.

Of the discovery itself, Belzoni has given a very clear description, and his drawings present a perfect idea of the entrances, passages

and chambers. Of the labor of the undertaking no one can form an idea. Notwithstanding the masses of stone which he had to remove, the hardness of the material, and the drifting sands* which impeded his progress, the whole was effected entirely at his own risk and expense.

It is manifest from the inscription discovered by Belzoni, as well as from the state of the chambers in the two large pyramids, that they had been opened at the distance of many years. Dr. Shaw, on the authority of an Arabian author, mentions that the one attributed to Cheops was entered about ten centuries ago by Almamon, the renowned Caliph of Babylon. It is added that the explorers found in it, towards the top, a chamber with a hollow stone, in which there was a statue like a man, and within it the body of a man, upon which was a breastplate of gold set with jewels. Upon this breastplate was a sword of inestimable price; and at its head a carbuncle of the bigness of an egg, shining like the light of day; and upon the human figure

* For an account of the drifting sands of Egypt see page 267.

were characters written with a pen, which no man understood.

Other pyramids of Egypt located at Abour-sir, Sakhara, Dashour, and other places, are known to be somewhat inferior to those which are above described; yet they rank very high as the remains of art left by a great people, whose glory, unfortunately, is now almost entirely reflected from the ruins of their ancient works. These pyramids are generally coated with a material different from the body of the edifice; and moreover, that so far as they have been inspected in their structure and internal distribution, they bear a striking resemblance to the more stupendous erections at Djireh.

The largest pyramid of Egypt engaged 360,000 workmen fifty years to build it, and has now stood, at least, over 3,000 years.

THE GREAT SPHINX OF EGYPT.

This wonderful work of art has always been regarded as an accompaniment, and sometimes even as a rival to the pyramids. The latest information in regard to this stupendous figure was obtained from the persevering labors of Mr. Caviglia, whose name has been already mentioned with so much honor. After the most fatiguing and anxious endeavors, during several months, he succeeded in laying open the whole statue of this wouderful image to its base, and exposing a clear area extending to a hundred feet from its front. It is not easy, says Mr. Salt, who wintessed the process of excavation, for any person unused to operations of this kind, to form the smallest idea of the difficulties which he had to surmount, more especially when working at the bottom of the trench; for, in spite of every precaution, the slightest breath of wind or concussion set all the surrounding particles of sand in motion, so that the sloping sides

began to crumble away, and mass after mass come tumbling down, till the whole surface bore no unapt resemblance to a cascade of water. Even when the sides appeared most firm, if the laborers suspended their work but for an hour, they found on their return that they had the greater part of it to do over again. This was particularly the case on the southern side of the paw, where the whole of the people, from sixty to a hundred, were employed for seven days without making any sensible advance, the sand rolling down in one continual torrent. But the discovery amply rewarded the toil and exposure which were incurred in revealing the structure of this wonderful work of art. The huge paws stretched out fifty feet in advance from the body, which is in a cumbent posture; fragments of an enormous beard were found resting beneath the chin; and there were seen all the appendages of a temple, granite tablet, and altar, arranged on a regular platform immediately in front. On this pavement, and at an equal distance between the paws of the sphinx, was the large slab of granite tablet, being not less than fourteen feet high, seven

broad, and two thick. The face of this stone, which fronted the east, was highly embellished with sculptures in bas-relief, the subject representing two sphinxes seated on pedestals, priests holding out offerings, while there was a long inscription in hieroglyphics most beautifully executed; the whole design being covered at the top, and protected, as it were, with the sacred globe, the serpent and the wings. The other tablets of calcareous stone similarly ornamented, were supposed, together with that of granite, to have constituted part of a miniature temple, by being placed one on each side of the latter, and at right angles to it. One of them, in fact, was still remaining in its place; of the other, which was thrown down and broken, fragments are now in the British Museum. A small lion, couching in front of this edifice, had its eyes directed towards the sphinx. There were, besides, several fragments of other lions rudely carved, and the forepart of a sphinx of tolerable workmanship; all of which, as well as the tablets, walls and platforms on which the little temple stood, were ornamented with red paint, a color which would seem to have been

in Egypt, as well as in India, appropriated to sacred purposes. In front of the temple was a granite altar with one of the four projections or horns still retaining its place at the angle. From the effects of fire, evident on the stone, this altar, it is manifest, had been used for burnt offerings. On the side of the left paw of the great sphinx were cut several indistinct legends in Greek characters, addressed to different deities. On the second digit of the same was sculptured, in pretty deep letters, an inscription in verse; of which the subjoined translation was given by the late Dr. Young, whose extensive knowledge of antiquities enabled him at once to restore the defects of the original, and to convey its meaning in English:

The form stupendous here the gods have placed,
Sparing each spot of harvest-bearing land;
And with this mighty work have graced
A rocky isle encumbered once with sand.
Nor that fierce Sphinx that Thebes erewhile laid waste,
But great Latona's servant, mild and bland:
Watching that prince beloved, who fills the throne
Of Egypt's plains, and calls the Nile his own.
That heavenly monarch who his foes defies:
Like Vulcan powerful, and like Pallas wise.

On the digits of the southern paw were

only discovered a few of the usual dedicatory phrases in honor of Harpocrates, Mars and Homer. One inscription gives, as Mr. Salt reads it, to the Emperor Claudius the extraordinary appellation of the good spirit, an instance of flattery which can only be outdone by that of another inscription discovered in Upper Egypt, where Caracalla is styled "most pious," on the very stone from which the name of his murdered brother Geta had been erased by his own hand. On another small edifice in front of the sphinx was a legend with the name of Septimus Severus, in which that of Geta was obliterated as in the former, and as it also is on the triumphal arch erected by the same Emperor at Rome. The former inscription, however, is not to Claudius, but to his successor, Nero, as may be distinctly traced in the first line as it now appears.

The sphinx, this remarkable statue, is as much under the dominion of the sandy desert as it was half a century ago; and, consequently, it now meets the eye of the Egyptian traveler shrouded in sand to the same depth as before. Dr. Richardson relates that the wind and the Arabs had replaced the covering

on this venerable piece of antiquity, and hence the lower parts were quite invisible. The breast, shoulders and neck, which are those of a human being, remain uncovered, as also the back, which is that of a lion; the neck is very much eroded, and, to a person near, the head seems as if it were too heavy for its support. The headdress has the appearance of an old-fashioned wig, projecting out about the ears like the hair of the Barbere Arabs; the ears project considerably, the nose is broken, the whole face has been painted red, which is the color assigned to the ancient inhabitants of Egypt, and to all the deities of the country except Osiris. The features are Nubian, or what, from ancient representation, may be called ancient Egypt, which is quite different from the negro feature. The expression is particularly placid and benign; so much so that the worshiper of the sphinx might hold up his god as superior to all the other gods of wood or stone which the blinded natives worshiped. He adds that there is no opening found in the body of the sphinx, whereby to ascertain whether it is hollow or not; but we learn from Dr. Pococke that there

is an entrance both in the back and the top of the head, the latter of which, he thinks, might serve for the arts of the priests when uttering oracles, while the former might be meant for descending to the apartments beneath.

DIMENSIONS OF THE SPHINX.

Mr. Pococke found the head and neck, all that were above ground, to be twenty-seven feet high; the breast was thirty-nine feet wide, and the entire length about a hundred and thirty feet. Pliny estimated it at a hundred and thirteen feet long, and sixty-three feet in height. According to Dr. Richardson, the stretch of the back is about a hundred and twenty feet, and the elevation of the head above the sand from thirty to thirty-five feet, a result which accords pretty nearly with the measurement of Coutelle. It is obvious that the discrepancy in these reports, as to the elevation of the sphinx, must be attributed to the varying depth of the sand, which appears to have accumulated greatly since the days of the Roman naturalist. The sphinx was entire in the time of Abdollatiph, who describes its graceful appearance and the admirable pro-

portion in the different features of the countenance, which excited his astonishment above everything he had seen in Egypt.

Makrisi states that it was mutilated by the Sheik Mohammed, who, in the spirit of a true Mussulman, thought himself bound to destroy all images, and everything, indeed, which bore the slightest resemblance to a living creature. He was called the Tartar, an expression which denoted his rigid adherence to the rules of his church; while his attack on the sphinx, and on the stone lions at the gates of Cairo, established his reputation as a furious bigot.

WONDERS OF THE WORLD.

The Brass Statue of Rhodes, historically known as the Colossus of Rhodes, was built 288 years before Christ, and made wholly of bronze. It represented Phœbus, the national deity of the Rhodians. It stood astride the harbor of Rhodes. It was 121 feet high, and ships passing in or out of the harbor had to pass between its legs. It was cast on metal plates, and afterwards joined together; this process occupied twelve years. In the interior was a spiral stairway reaching into its head, and a great mirror suspended to its neck, which reflected the coast of Syria and the ships sailing to Egypt. But few men could clasp its thumb. It stood there for 66 years, and was thrown down by an earthquake. This Colossus lay on the shore 923 years, the remains were sold by the Saracens to a Hebrew dealer, in the year A. D. 635, who loaded 900 camels with the bronze. The original cost was 300 talents, or six millions of dollars.

The Alexandian pillar stands on a pedestal 12 feet high. The shaft is round, 90 feet in length, and surrounded by a corinthian capital, which adds ten feet more to its elevation. The column is believed to be one solid block of porphyry nine feet in diameter.

Cleopatra's Needle, in Egypt, built by Cleopatra, is a fine piece of granite, which is covered with hieroglyphics. This is eight feet square at the base, tapering to the top, and is sixty-four feet in height.

The Labyrinth of Psalmetichus on the banks of the Nile, contains within one enclosure 1,000 houses and twelve royal palaces, all covered with marble, and having only one entrance. The building was said to contain 3,000 chambers, and a hall built of marble, adorned with statues of the gods.

The Pharos of Alexander, a tower of Ptolemy Philadelphus, was built 172 years before Christ. It was erected as a light house, and contained magnificent galleries of marble, a large lantern at the top, the light of which was seen nearly a hundred miles off. Mirrors of an enormous size were fixed around the galleries, reflecting everything on the sea. A

common tower is now erected in the same place.

The Temple of Diana at Ephesus, was completed in the reign of Servius, the sixth King of Rome. It was 450 feet long, 200 broad and supported by 123 marble pillars.

A TEMPLE IN HONOR OF MINERVA.

Herodotus mentions a temple erected at Sais, in honor of Minerva. The historian observes that what, in his opinion, was most of all to be admired, was a sanctuary brought by Amasis from Elephantine, consisting of one entire stone. The carriage of it employed two thousand men, all sailors, for the whole period of three years.

The length of this edifice, if it may be so called, was twenty-one cubits, the width fourteen cubits and the height eight cubits. It was placed at the entrance of the temple; and the reason assigned for its being carried no farther is, that the architect, reflecting upon his long fatigue, sighed deeply, and thereby alarmed the superstitions of the king, who considered it a bad omen. Some, however, affirmed that one of the men employed in working a lever was crushed to death, an event which discouraged Amasis and induced him to desist from his enterprise.

We know that the practice of erecting monlithic temples, or sanctuaries hollowed out of a single stone, was very general in Egypt; some striking specimens being still preserved in the higher parts of the country. But we question whether the power of modern mechanics could remove from the quarry, and convey to the distance of four hundred miles, masses of rock thirty-two feet long, twenty-one feet broad, and twelve feet in height. It is only in a nation where the pyramids continue to bear witness to the astonishing effects produced by labor and perseverance, that such things must not be pronounced incredible.

The obelisks, too, some of which adorn more than one capital city in Europe, prove that the resources of the Egyptian engineer are not to be measured by the progress of similar arts, at the same period, in any part of Italy or Greece.

Mr. Champollion states that the learning of an ancient Egyptian, like the similar acquirements of the modern Chinese, would be measured by the number of hieroglyphic or ideographic signs which he was able to interpret. This remark applies almost exclusively to the

figurative and symbolic classes, which, instead of sounds, denoted things or qualities. But as there were scarcely any pieces of composition executed entirely in phonetic characters, and without a considerable intermixture of the two others, the means of acquiring knowledge among the subjects of the Pharaohs must have been extremely limited. Perhaps at a more advanced period of hieroglyphical discovery, we shall find that many of the signs which are at present esteemed symbolical were also used alphabetically, an expectation which has unquestionably been rendered more probable by the recent investigation of Champollion among the ancient monuments of Egypt. This indefatigable author has arrived at the following conclusion, founded on personal research, and supported by the results published by other travelers:

1. That the phonetic hieroglyphic alphabet can be applied with success to the legends of every epoch indiscriminately, and is the true key of the whole hieroglyphical system.

2. That the ancient Egyptians constantly employed this alphabet to represent the sound of the words in their language.

3. That all hieroglyphical inscriptions are composed of signs, which, for the greatest part, are purely alphabetical.

4. That these alphabetical signs are of three different kinds, the demotic, hieratic and hieroglyphical, strictly so called.

Lastly, that the principles of this graphic system are precisely those which were in use among the ancient Egyptians. The hieroglyphical alphabet which he has already discovered, includes nearly nine hundred characters, some of which are exclusively phonetic, but the greater number appear also to combine the properties of the figurative and the symbolical orders.

The ancient popular religion of Egypt, like that of all pagan tribes, was directed towards those qualities in the physical system of the universe upon which the permanence of the animal kingdom is known to depend. The generative and prolific powers, under their various forms, and as affecting every description of organized matter, were worshiped as the Universal Parent, whose names were multiplied according to the changing aspect of nature, and whose attributes, when personified,

gave birth to a thousand subordinate divinities. The tenet of the metempsychosis appears to have regulated the faith of the people so far as it applied to the effect of their conduct on their future condition.

The soul was understood to expiate the sins committed in the human body, or to enjoy the rewards due to pureness of living, in a succession of transmigrations during three thousand years; at the end of which it was expected to return to its former tenement, and to discharge once more the functions of an earthly existence. This belief was probably the cause of their rulers building their monuments for their resting place for the space of the above three thousand years.

THE GREAT WALL OF CHINA.

For three hundred years after the death of Confucius, the internal peace of China was incessantly disturbed by the wars and quarrels of the petty kings, whom the emperors were unable to keep in subjection, and who constantly refused to pay their tribute. At length there came to the throne a prince named Chi-hoang-ti, a great warrior, who resolved to put an end to these troubles by uniting all the small kingdoms into one monarchy. There was no difficulty in finding pretexts for invading the several States of the tributary kings, as scarcely a year passed but one or the other of them rebelled against his authority. By degrees, however, he conquered them all, and after some years became master of the whole empire, about two hundred years before the Christian era; and was the first monarch of the dynasty called Tsin, or Chin. The chief government now began to assume the aspect of an Empire, which comprehended all

that half of modern China which lies to the north of the great Keang river. When Chihong-ti had subdued all the petty princes, he turned his arms against the Tartars, who had become very troublesome neighbors, making frequent hostile incursions into the Chinese territories. They were portions of the same people who, in European history, are called Huns. They consisted of various tribes, who wandered about the barren plains of Central Asia, living partly by hunting and partly by plunder; and as they were a much more warlike people than the Chinese, they were enemies very greatly to be dreaded. The emperor, therefore, devised a plan to keep off their invasions, by erecting a wall along the whole extent of the northern frontier, of such a height, thickness, and solidity, as to be proof against any attempts which might be made, either to scale or to effect a breach in it.

In order to obtain a sufficient number of workmen for so vast an undertaking as the building of the Great Wall, the emperor ordered that every third laboring man throughout the empire should be compelled to enter his service; and they were forced to labor

like slaves, without receiving any compensation beyond a bare supply of food. The wall extended fifteen hundred miles from the sea to the most western province of Shensee. It was carried over the highest mountains, through the deepest valleys, and by means of arches, across rivers. Its breadth was sufficient to allow of six horsemen riding abreast on its summit, and it was fortified by strong towers, built at equal distances, of about one hundred yards, in which guards were stationed.

The exterior was formed of stone and brick, of the most solid construction, which was filled in with earth, so as to render it impenetrable; and the whole was finished in the short space of five years.

Such is the account generally given of the Great Wall of China, which has now stood for two thousand years, and has been regarded as one of the wonders of the world. Lord Macartney exclaimed, on seeing it, that it was certainly the most stupendous work of human hands, and he rationally concluded that, at the remote period of its building, China must have been a very powerful and civilized empire. Dr. Johnson was accustomed to say of it, that

it would be an honor to any man to be able to say that his grandfather had seen the great wall of China. Mr. Barrow, who saw it with Lord Macartney, went into some amusing calculations as to the quantity of the materials it contained. According to his account, all the materials of all the dwelling houses of England and Scotland, supposing them at that period (the end of the last century) to amount to 1,800,000, and average 2,000 cubic feet of brickwork or masonry, would be barely equivalent to the bulk of the wall, without taking in its fortresses and towers, which he calculated contained as much masonry and brickwork as all London did at that time. Stupendous as was the work, we shall presently see that it failed of its object.

Chi-hoang-ti, a title which literally signifies the First Emperor, seems to have been a prince who, in all things, was extremely ambitious of fame; for although he had rendered his name immortal by the stupendous work just described, he aspired to still higher renown, and even entertained the vainglorious desire that his name should be handed down to posterity as the founder of the Chinese monarchy.

The custom of bestowing territories on the princes of the royal family was abolished by Chi-hoang-ti, who saw that these petty sovereignties were sure to occasion civil warfare. He therefore provided for his family by giving to each of his immediate male relatives a palace in one of the great cities, with a suitable maintenance, and the privilege of wearing yellow, which was then, as it is now, the imperial color, and, as a distinctive mark of rank, is highly valued. A yellow girdle has a greater degree of importance in China than a blue ribbon in England. It is always a sign that the wearer is nearly related to the Emperor.

The prince chosen by Chi-hoang-ti as his successor happening to be absent at the time of his father's death, a younger son took advantage of the circumstance to seize on the sovereignty, and contrived to have his brother secretly strangled. But the usurper did not long enjoy the fruits of his crime, for he made himself so unpopular by neglecting the affairs of the State, and attending to nothing but his own pleasures, that a formidable insurrection broke out in the country, headed by the chief of a band of freebooters, named Lin-pang, a

man distinguished by many noble qualities, although he was no better than a robber.

It is related of this adventurer, that just after the breaking out of the rebellion he happened to meet a fortune-teller on the road, who, falling at his feet, said he offered him this mark of homage because he saw by the lines in his face that he was destined shortly to become emperor.

In making this prediction, the soothsayer, no doubt, foresaw the probability of its accomplishment, for it was not an unlikely termination of the rebellion that the leader, if successful, should be placed on the throne: with this belief, therefore, the stranger followed up his prophecy by offering his only daughter in marriage to the chief.

Lin-pang accepted the proposal, and married the lady, who was thus, by her father's artifice, raised to the dignity of empress; for, after many scenes of violence and bloodshed, in which the lawful emperor lost his life, the insurgents were victorious, and their leader was raised to the imperial throne.

But there was one great obstacle to the attainment of this end, which none but the

veriest tyrant would have thought of removing; and that was the existence of a vast number of books, wherein might be read the histories of those who had reigned before him.

The Emperor, however, was one of those who would sacrifice everything which stands between them and the object on which they had set their hearts; therefore he issued a preemptory order that all books and writings of every description should be collected and burned by the magistrates of each district throughout the whole empire; and the decree was so strictly enforced, that many literary men were put to death for being detected in an attempt to save some valuable records.

But the tyrant, whose mischievous ambition had tempted him to commit such an act of madness, missed the end he had in view; for, in spite of all his precautions, several copies of the works of Confucius, and some other eminent authors, were hidden behind the walls and under the floors of different houses, where they remained until the death of the Emperor rendered it safe to bring them again to light.

It is related of this same prince that when

dying, he commanded that his favorite wife and a number of slaves should be buried with him.

This dreadful custom had existed in the barbarous ages, and was common among the Tartars and Hindoôs, not only at the death of princes, but also at those of all classes of the people, from a superstitious belief that the wives and domestics thus interred would pass with the deceased into the next world, and be ready to attend upon him there.

With the same idea the Chinese used in later times to bury clothes, furniture, and even food, for the use of the departed, with a number of effigies in the likeness of slaves, and this harmless custom has been continued down to the present time, with this difference, that every article now sacrificed is made of paper, millions of bundles being consumed annually in these pious but superstitious rites.

The revolting practice of immolating human beings had, however, been so long out of date, that it is mentioned, in reference to this period, as a relic of the barbarism of distant ages. Chi-hoang-ti appointed his eldest son to succeed him, a case of rare occurrence.

CITY AND TOWER OF BABEL,* OR BABYLON.

It appears that the primitive fathers of mankind, having from the time of the deluge wandered about without a fixed abode for one hundred and two years after the flood, at length settled on the vast extended plain of Shinar, where they took up a permanent residence.

As yet they had remained together, and all spoke the same language. Here they made brick, and using bitumen for a cement, they built a city and a tower of vast extent and elevation. Aben Ezra says those who built the tower and city of Bạbẹl wished for a city which should be a common residence of Babylonia, to prevent the traveler from losing his way while passing over the wide, level and

* Babel (Confusion) is taken from a Hebrew word. Babylon is taken from a Greek word. Another writer calls it the Court or City of Belus. One writer calls it Babylon the Great. Josephus calls it Babylon, of the Babylonio-Chaldean Empire. They all refer to the same place and have the same meaning.

extensive plain of Babylonia, where scarcely one object exists different from another to guide the traveler in his journeying, and which in those days, as at present, were a sea of land, without monuments to guide, and the compass being then unknown. They also took measures for their own convenience, and also to make themselves a name with future ages.

One writer assigns as a reason of the overthrow and confusion, the displeasure of God at seeing them act so madly under the direction of Nimrod, a bold, bad man, who, in order to alienate the minds of the people from God, and to take revenge for the deluge, which had destroyed their forefathers, induced them to build a tower too high for the waters to reach. Another historian says their design was not to secure themselves against a second deluge, otherwise they would have built their town on a high mountain, not on a low plain; but to get to themselves a famous character, and a name with future ages, and to prevent their dispersion upon the earth. They were employed three years in preparing materials for the tower and city, and twenty-two years in building the same.

The opinion of Heeren is far different, and more correct. There is, says he, perhaps nowhere else to be found a narrative so venerable for its antiquity, or so important in the history of civilization, in which we have at once preserved the traces of primeval international commerce, the first political associations, and the first erection of secure and permanent buildings. A comparison of this narrative with the absurd or visionary pictures which the Greeks and Romans give of the primitive condition of mankind, will gratify the student of the Bible, and confirm the faith of the Christian, by showing the marked difference there is between the history contained in Genesis and the fictions of the poet, or the traditions of the mythologist.

Babylon, as the centre of a great kingdom, was the seat of boundless luxury, and its inhabitants were notorious for their addiction to self-indulgence and effeminacy. G. Curtius asserts that nothing could be more corrupt than its morals, nothing more fitted to excite and allure to immoderate pleasures. The rights of hospitality were polluted by the grossest and most shameful lusts. Money dis-

solved every tie, whether of kindred, respect, or esteem. The Babylonians were very greatly given to wine, and the enjoyments which accompany inebriety. Women were present at their convivialities, first with some degree of propriety, but growing worse and worse by degrees, they ended by throwing off their modesty and their clothing at once. On the ground of their awful wickedness, the Babylonians were threatened with condign punishment, through the mouths of prophets; and the tyranny with which the rulers of the city exercised their sway was not without a decided effect in bringing upon them the terrific consequences of the divine vengeance. Not in the whole range of literature is there anything to be found approaching to the sublimity, force and terror with which Isaiah and others speak on this painful subject. Their haughty and rebellious attempt displeased the Lord, and by a miracle, he so confounded their language, that but few of them could understand each other. This effectually stopped the building, and procured it the name of Babel, or Confusion, and obliged the offspring of Noah to disperse themselves and replenish the world.

It is pretended that the family of Ham did not concur in erecting the structure, but of this we have no certain evidence. What became of this tower we cannot determine. About 1700 years after its erection, Herodotus saw a structure at Babylon consisting of eight towers, raised one above another, and each 75 feet high, making the structure 600 feet high, above the highest of which was built the temple of Belus, the way to which wound about on the outside, and was so broad that carts could have passed each other; but whether this was that mentioned by Moses, or one built on its foundation, we know not. Modern travelers, who pretend to have seen the ruins of this structure, differ so widely among themselves, both with respect to situation and description, that it is impossible that any of them have seen the genuine ruins of the famous tower.

Babel, or Babylon, the capital of Chaldea, was one of the most splendid cities that ever existed. Its form was an exact square, built on a large plain; its circumference 480 furlongs, or 60 miles—fifteen miles on each side. The walls were in thickness 87 feet, in height

350 feet, on which were built 316 towers, or, according to others, 250 towers, three between each gate, and seven at each corner, at least where the adjacent morass reached not almost to the wall. These walls and towers were constructed of large bricks, cemented with bitumen, a glutinous slime, which in that country issues out of the earth, and in a short time grows harder than the bricks or stone which it cements. Without the wall the city was surrounded by a ditch, filled with water, and lined with bricks on both sides. This must have been extremely deep and large, as the whole earth of which the bricks for building the walls were formed was dug out of it. There were 100 gates in all, 25 on each side, and all of them of solid brass. From these ran 25 streets, crossing one another at right angles, each one 150 feet wide and 15 miles in length. A row of houses faced the wall on every side, with a street of 200 feet between them and the wall. Thus the whole city was divided into 676 squares, each four furlongs and a half on every side. Around these squares stood the houses fronting the streets, and the empty spaces within served for gar-

dens and other necessary purposes; but it does not appear that all these squares were ever wholly inhabited, though from Curtis' account of it, when Alexander was there, we cannot safely infer what part might be inhabited, and in its meridian lustre before Cyrus took it.

A branch, if not the whole current of the Euphrates, running through the city from north to south, divided it into two parts. On each side of the river was a quay and a high wall, of the same thickness with that of the city. In this, over against every street, were bronze gates, and from them a descent by steps to the river. A magnificent bridge, of a furlong or more in length, and thirty feet wide, joined the two parts of the city in the middle. To lay its foundation and raise banks, they turned off the river westward into a prodigious lake which they had dug, of about 52 miles square, and 35, or, according to Megasthenes, 75 feet deep. To prevent the Euphrates from damaging the city, when the melting of the Armenian snows yearly caused it to overflow its banks, part of the current was then diverted into this lake, and after-

wards, on proper occasions, drawn forth to moisten the fields that lay below the line of the city. At the east end of this stately bridge stood the old palace, which took up four squares, and was about four miles in circumference. Next to it stood the magnificent temple of the god Bel, or Belus, on the top of the tower above mentioned, and which took up one square. The riches of this temple, we read, amounted to above twenty-one millions sterling. Its statues and vessels were all of massive gold. The statue of Jupiter, probably that which Nebuchadnezzar erected in the plain of Dura, was 40 feet high, and weighed 1000 Babylonian talents, or about three millions and a half of our money. The statue of the goddess Rhea was of the same weight and value. The goddess was seated on a golden throne, with lions at each knee, and two serpents of silver. The statue of Juno was erect, like that of Jupiter, weighing 800 talents. She grasped a serpent by the head with her right hand, and held in her left a sceptre enriched with gems. The statues of Jupiter, Juno and Rhea were of solid gold. They had a golden table before them, 40 feet long and

15 broad. On the table were two goblets of 30 talents, and two censors of 500 talents each, and three vases of prodigious magnitude, all of solid gold. Here Nebuchadnezzar deposited the sacred furniture of the Jewish temple, and a great part of his other precious spoils. At the west end of the bridge stood the new palace, which took up about nine squares, and was seven or eight miles in circumference. On the walls of these palaces an infinity of animals were represented to the life; and the several entrances were by magnificent gates of brass. A vault below the channel of the river afforded a secret communication between the two palaces.

But nothing was more interesting than the terrace gardens. To gratify his queen Amyti with a resemblance of her native mountains of Media, or to have a commanding prospect of the whole city, Nebuchadnezzar built them by his own palace. They contained a square of 400 feet on each side, and consisted of terraces, one above another, raised to the height of the walls of the city, the ascent from terrace to terrace being by steps 10 feet wide. The whole pile

consisted of substantial arches upon arches, and was strengthened with a surrounding wall of 22 feet thick. The floors on each terrace were laid in the following order: first, on the top of the arches was laid a bed or pavement of stones, each 16 feet long and four broad; over this, a layer of reed, mixed with a great quantity of bitumen; over this, two courses of brick, closely connected with plaster; over all these were thick sheets of lead, and on these the earth or mould of the garden, so deep as to give sufficient root to the largest trees, and stocked with the choicest shrubs and flowers. Upon the uppermost terrace was a reservoir, supplied by a powerful engine with water from the river, and from whence the gardens on the other terraces were supplied with moisture.

Nimrod, the first king of Babylon, and perhaps in the world, is generally allowed to have founded the city. Belus, who by some is made cotemporary with Shamgar, Judge of Israel, and Queen Semiramis, are said to have further enlarged and adorned it; but Nebuchadnezzar, or he and Nitocris, his daughter-in-law, finished it, and made it one of the wonders of the world.

The inhabitants of Babylon and places adjacent were excessively credulous, superstitious, lewd and debauched; parents and husbands exposed for sale the chastity of their daughters and wives; their women scarce retained the least shadow of modesty, exposing themselves quite naked in companies. They were obliged by law, once in their lives, to prostitute themselves to strangers, in honor of their goddess, Succoth-benoth. The other idols of the Babylonians were Bil, Nibo, Sheshach, Nirgal, Merodach, and the element of fire. Here the idolatry, afterwards so prevalent in every place, appears to have had its origin. The Babylonians pretended to great skill in astrology, soothsaying and magic. From hence these pretended sciences spread into Canaan, if not into Egypt. After the death of Nimrod, Amraphel, the ally, if not the tributary of Chedorlaomer, was king of Shinar, where Babylon stood. Long afterwards, reigned Belus, who is considered to be the same with Pul, king of Assyria. He appears to have left Babylon to Baladan, Belesis, or Nabonassar, his younger son; and hence his son, Merodach, and other successors, enjoyed their

dominion with the connivance of the elder branch of that family, who reigned in Assyria and extended their conquests. Some, however, think that Baladan was not the brother, but a revolter from Tiglathpiliser.

About A. M. 3323, Esarhaddon, king of Assyria, either for its want of male heirs, or by force, seized on the kingdom of Babylon. After he and his posterity had retained it about sixty years, Nabopolassar, perhaps a descendant of Baladan, revolted, and ascended the throne. He, with Cyaparis, the Mede, began the overthrow of the Assyrian empire, and his son Nebuchadnezzar completed it, and raised the Babylonian empire to its summit of glory. When Nebuchadnezzar conquered Jerusalem, and leveled most of the city with the ground, he brought away the treasures of the temple and the treasures of the king's house, and put them all into the temple of Bil at Babylon. His conquest extended from Media, on the north-east, to Ethiopia, beyond Egypt, on the south-west, comprehending the kingdoms of Assyria, Persia, Syra, Phœnecia, North Arabia, Idumea, Egypt, &c. After his death the empire of

Babylon began to dwindle into decay. Evilmerodach, his son, succeeded him. Niriglissoror, a son-in-law of Nebuchadnezzar, murdered him; and he and his infant son, Laboroschord, reigned a few years; the last being murdered, Belshazzar, the grandson of Nebuchadnezzar by Evilmerodach, mounted the throne; under whom, after a long war with the Medes and Persians, Babylon was taken by Cyrus. Terrible ravages and slaughter ensued, and the whole royal family was ignominiously cut off, A. M. 3468. About fifteen years after, the Babylonians were enraged that the royal residence was transferred to Shushan in Persia, and for other grievances, pretended or real, prepared to revolt, and after four years preparation, avowed their rebellion. Darius Hystarpis, king of Persia, with a mighty army, marched to reduce them. Trusting to their walls, they shut themselves up in their city, where they had collected great stores of provisions; and that this might not be consumed by useless persons, they assembled their old people, their wives and children, and strangled all unfit for arms, except one beloved wife and a maid for every family. After

Darius had, without success, invested the city almost two years, Zopyrus, one of his generals, cut off his own nose, and mangled his face; he fled over to the besieged, and pretending that all this had been done to him by Darius' orders, for speaking in favor of the Babylonians, was readily admitted. He so bitterly inveighed against the cruelty of Darius, that they made him captain of some troops, and at last governor of their city. This, on the first opportunity, he treacherously surrendered to his master, who, to reward his successful stratagem, loaded him with honor and wealth. Three thousand of the principal revolters were severely punished with impalement, the walls of the city reduced to one-third or one-fourth of their former height, and the brazen gates carried off. About forty years afterwards, Xerxes pillaged the temples, and destroyed the idols of Babylon. When Alexander was here, about A. M. 3672, Babylon was still extensive and wealthy, and he intended to restore it to its former splendor, and make it the seat of his empire; but soon after, Sileucus Nicator, having drained about 500,000 persons from it, to people his new city of Sitin-

cia, forty miles northward, it gradually dwindled into a desert. About A. M. 3870, one of the Parthian kings cruelly ravaged it and demolished part of it.

In Curtin's time it was reduced to a fourth part. The river Euphrates, changing its course, turned part of it into a fen, or standing pool of water. About the time of our Saviour's death it was quite desolate; not 400 years after it was a hunting park for the Persian kings. From the accounts of Rawolf, De la Valle, and Hanway, we are informed that now, and for ages past, it is so completely barren that it is hard to say where it is supposed to have stood; and that the place is so haunted with venomous and other doleful creatures, that no one dare go near it, except during the two winter months. Babylon, or Babylonia, was also the name of the country about this famed city; and sometimes also of Chaldea. This province contained the cities of Babylon, Vologesocerta, Borsippa, Idiecara, Coche, Sura, and Pompeditha. Here the apostle Peter wrote one, if not both his epistles, to his dispersed brethren of Judah.

DESTRUCTION OF ROCKS.

"If in contemplating," says Dr. Macculloch, "the towering peaks and the solid precipices of an alpine region, braving the fury of the elements and the floods of winter, the spectator is at first impressed with the character of strength and solidity, which nature here seems to have conferred on her works, it requires but a moment's reflection to show that everything around him bears the marks of ruin and decay. Here he learns to withhold his regret at the perishable nature of all human labors; at the fall of the strong tower and the solid pyramid, when he sees that the most massive rocks, those mountains which seem calculated for eternal duration, bear alike the marks of vicissitude and the traces of ruin."

"In these great revolutions, however, other agents must co-operate; and the first here to be considered is the power of frost. Expanding as it freezes, the water which has entered the fissures acts with irresistable force, and detaches those enormous masses, which in the

seasons of winter and spring daily fall from the mountains. In Greenland, it is said that these effects often take place with a noise emulating thunder; but if less conspicuous, they are sufficiently common in all alpine regions that are subject to the extreme vicissitudes of heat and cold.

To this cause, in a great measure, is to be attributed the ruin of sea cliffs, which on some coasts present such striking and singular appearances. The constant action of the ocean lashing the inferior parts of these cliffs, also produces its effects, and is often the cause of large masses being precipitated into the water. The perpetual rubbing of the smaller stones against the larger, on the borders of the sea, is another cause, which in the course of time produces considerable effect; and hence all such stones have lost their angles, and become completely smooth and rounded.

FALL OF MOUNT GRENIER.

The fall of a part of Mount Grenier, one of the calcareous mountains of Savoy, illustrates the effects of frost, and the gradual undermining of rocks by torrents. Mount Grenier

is upwards of 4000 feet high, and rises abruptly above the plain on which it stands. The top, or cap, is an immense mass of limestone, 600 feet thick, below which are strata of a softer kind, and it is to the decay of the latter that the fall is attributed, the cap being undermined by the gradual erosion and removal of the under strata. The fall took place in the year 1248. The larger masses, says Mr. Bakewell, evidently came from the upper, or highest part of the mountain, and the velocity they acquired by the fall must have been at least 300 feet per second, before they reached the ground. As these immense masses struck obliquely against the base of the mountain, they thus acquired a projectile force which spread them far into the plain. These masses were in such quantity and were projected to such distances, as to cover nine square miles of surface, and to entirely bury five parishes, together with the town and church of St. Andre. In the course of years the rains, or currents of water from dissolving snow, have furrowed channels between the larger masses of stone, and washing away part of the loose earth, have left an immense number of conical

hills still remaining. So deep and vast was the mass of ruins which covered the town of St. Andre, and the other parishes, that except a small bronze statue, no individual article belonging to any of them has been found to this day.

FALL OF ROCKS FROM THE ALPS.

A part of a mountain near Servos, belonging to the Alpine range, and on the road to Chamouny, fell down in the year 1751. This continued several days, mass after mass being precipitated, while an immense volume of dust, the consequence of friction, by the sliding of the rocks on each other, rose so high and was so dense as to have been seen at the distance of twenty-five miles. A succession of reports, like the firing of heavy canon, announced the fall of these masses day and night. The aggregate amount thus precipitated was estimated by Donati at 3,000,000 of cubic fathoms, or 15,000,000 of cubic feet, a quantity sufficient to form a large hill.

POWER OF MOVING BODIES.

Before speaking of the destroying effects of the ocean, it may be well to speak of the power of moving bodies.

The velocities of bodies are equal when they pass over equal spaces in the same time; but the force with which bodies, moving at the same rate, overcome impediments, is in proportion to the quantity of matter they contain. This power or force is called the momentum of the moving body. Thus, if two bodies of the same weight move with the same velocity, their momenta will be equal.

Two vessels, each of a hundred tons, sailing at the rate of six miles an hour, would overcome the same impediments or be stopped by the same obstruction. Their momenta would, therefore, be the same.

The force or momentum of a moving body is in proportion to its quantity of matter and its velocity. A large body, moving slowly, may have less momentum than a small one

running rapidly. Thus, a bullet shot out of a gun moves with much greater force than a stone thrown by the hand.

The momentum of a body is found by multiplying its quantity of matter by its velocity per second. Thus, if the velocity be 2, and the weight 2, the momentum will be 4. If the velocity be 8, and the weight 5, the momentum or power will be 40.

If a moving body strikes an impediment, the force with which it strikes and the resistance of the impediment are equal. Thus, if a boy throws a ball against the side of the house with the force of 3, the house resists it with an equal force, and the ball rebounds. If he throws it against a pane of glass with the same force, the glass having only the power of 2 to resist, the ball will go through the glass, still retaining one-third of its force.

PILE DRIVER.

This machine consists of a frame and pulley, by which a large piece of cast-iron, called the hammer, is raised to the height of thirty or forty feet, and then let fall on the end of a perpendicular beam of wood, called a pile,

and by which it is driven into the ground. When the hammer is large and height considerable, the force or momentum is tremendous, and unless the pile is hooped with iron, it will be split into fragments.

Now the momentum of a body being in proportion to its weight and velocity conjointly, to find it we must multiply their two sums together. Suppose the weight of the hammer is 2,000 pounds, is elevated two seconds of time above the head of the pile, then, according to the law of falling bodies, it would fall sixty-four feet, this being the rate of its velocity. Then, 64 multiplied by 2,000, gives 128,000 pounds, or 64 tons, as the momentum. But according to the same law, this force is immensely increased by a small increase of time, for if we add two seconds of time, the rate of velocity at the instant of striking would be 256 feet per second, and thus 256 by 2,000 is equal to 512,000 pounds, or 256 tons.

The power of sea waves to move bodies is the same as other moving bodies, as the momentum is in proportion to the velocity with which the wave moves and the weight of water which the wave contains.

If a wave of water moves at the rate of 450 feet in two seconds of time, and the bulk of water in the wave weighs 8000 pounds, the force or momentum is formed by multiplying the number of feet it moves in two seconds by the number of pounds of water the wave contains. 450 feet multiplied by 8000 pounds, thus, $450 \times 8000 = 3{,}600{,}000$ pounds.

The gravel, sand and soil which the Mississippi river carries into the Gulf of Mexico in one year, is estimated to be enough to cover a square mile the depth of twenty-seven feet. That matter gradually deepens the channel by grinding along the bottom of the stream.

EXPORTING POWER OF WATER.

In estimating the transporting power of water, we are apt to forget its buoyancy, and on which indeed its power of moving heavy substances, such as rocks, in a great measure depends. The specific gravity of many rocks is little more than twice that of water, that of granite and limestone being about two and a half times, bulk for bulk, the weight of water.

Hence a stone weighing twenty-five pounds in the air, or under ordinary circumstances, will weigh only fifteen pounds when immersed in water. Those who have never tried the experiment of lifting a stone under water, will be surprised to find with what ease he can raise a block of granite to the surface, above which, however, with all his efforts he cannot lift it. If a man can lift a stone weighing one hundred pounds, whose specific gravity is two, in the air, he can lift one weighing two hundred pounds in the water, because the fluid lifts nearly one-half of its weight.

It is from our not taking this circumstance into account, that we are often surprised at the power of torrents of water to move stones of great size. According to experiments recorded in the Encyclopedia Britannica a velocity of water equal to three inches per second is sufficient to tear up fine clay,—six inches per second, fine sand—twelve inches per second, fine gravel—and three feet per second, small stones.

It is obvious, however, that the depth of the water will influence these results, and that the power of moving bodies will be in proportion to its depth and velocity.

Since the time of historical records, the power of running water has produced many and great changes in various parts of the world. In some instances lakes have been filled up, in others deep ravines have been formed, in others whole districts have been ruined in consequence of rivers having changed their beds, and in others considerable tracts of land have been accumulated, or sometimes swept away, by the force of mountain torrents. Around the whole circle of the globe, it appears from geological surveys, that large and

small boulders or fragments of rocks have been transported from their original ledges in the north southward, some of which measure about one thousand cubic yards. It may be readily understood that if a small stream of water will move a pebble, by the same law a great flood like the deluge will transport a mountain.

If it be inquired how it can be ascertained that blocks of granite have been transported from a distance, and that they do not belong to disrupted mountains in the vicinity in which they are found, it is answered that there is a peculiarity in every formation or range of rock or mountain. Different rocks have their own constituent principals or materials of which they are composed; granite is composed of quartz, feldspar and mica. Greenstone is composed of hornblend and feldspar; so with every species of rock, every one has its own particular materials of which it is composed. To the practiced eye of a mineralogist, combined with the analysis of the chemist, no difficulty occurs in identifying any specimen with the rock to which it belongs.

For instance, if we find a chestnut under a

walnut tree, and there being no chestnut tree within miles of where the chestnut is found among the walnuts, we know at once that the chestnut has been transported from some chestnut tree at a distance. Thus it is with rock, if there is no ledge of rock found in the vicinity composed of the same material with which the boulder is composed, we know the boulder has been transported from some distant ledge, composed of the same material of which the boulder is.

If the reader has ever noticed, after a heavy rain, the quantity of stone and gravel which has been brought down from the side of a hill, leaving a large quantity at the base, and scattering a portion of the same along for a considerable distance, running to a point where but a few or a single one is found, you can imagine how boulders were transported to the south by an immense flood, which ran from north southward, which swept the globe on every side and brought those boulders from a distance.

We have the conclusive geological evidence that there has been an immense flood of water which ran from the north southward, in some

instances moving mountains and large masses of rock and carrying the latter to a great distance. This was a universal flood, sweeping the globe on every side, carrying rock and other material southward. But we never find southern rock carried from the south to the north. The erratic rocks of Europe have all been moved southward.

Professor Hitchcock, in his report on the geology of Massachusetts, appears to have examined the diluvial deposits of that State with much attention, and has shown that the current there was also from the north and north-west, towards the south-east. The conclusion, says he, to which I have been irresistably forced by an examination of this stratum in Massachusetts, is that all the diluvium which had been previously accumulated by various agencies has been modified by a powerful deluge, sweeping from the north and north-west, over every part of the State, not excepting the highest mountains; and that since that deluge, none but alluvial agencies have been operating to change the surface.

A very large number of boulders consists chiefly of granite, sienite, and gneiss, with oc-

casionally masses of gray wacke conglomorate, common feldspar and porphyry, are scattered over the New England States.

Another class of effects or evidences, from which professor Hitchcock not only concludes that a mighty current of water once swept over the surface of Massachusetts, but from which he also infers its direction in the existence of grooves, furrows, and scratches now upon the surfaces of the rocks that have never been moved from their places. These grooves and scratches are in the direction of east of south.

The Alleghany Mountains cross the Hudson river at the Highlands and extending northward into Vermont, where they are called the Green Mountains. This range of mountains appears to have divided the waters of the flood, so that the flood on the east side of this range of mountains ran east of south; while that on the west side ran west of south, following the direction of the original valleys. In the State of New York we find the boulders were carried a little west of south. In the northern part of the valleys, we find large quantities of boulders of various kinds; but

as we go south we find less and less until they become very scattering. In the valley east of Clyde, Wayne county, N. Y., as we go north up this valley we find the ground almost literally covered with fragments of various kinds of northern primitive rocks. I have examined the country from the Atlantic ocean westward as far as the Falls of Niagara and found boulders of northern rocks scattered over the whole length and breadth of New York and the Eastern States. I found boulders of Canada granite in the southern tier of counties near the Pennsylvania line.

From the facts and circumstances thus thrown together, there is sufficient evidence that the earth has been deluged by a flood of water, which in its course transported great masses of rock from one place to another; excavated new valleys and filled up old ones; formed hills of diluvial detritus, and finally left its effects on the surface of the globe, which are almostev erywhere apparent at the present day on all sides of the globe.

It is not unreasonable to suppose that the South Sea once occupied its place at the north pole, and at the time of Noah's deluge it

changed its location from the north to the south pole, and in its transit it carried these boulders and other material southward.

On the secondary mountains of Jura, particularly on the slopes facing the Alps, a great many loose fragments of primitive rock, some of them containing a thousand cubic yards, occur, which were brought from the north, and thus we find them all around the globe.

There is no difficulty in conceiving that immense blocks of rock may be moved by water, since the weight lost by immersion is in exact proportion to the bulk; and therefore, if a little brook will move a pebble, by the same law a great flood will transport a mountain. Many of the plains in the north of Europe exhibit on their surfaces large blocks of granite, called boulders, with their sharp angles worn off, showing that they have been rolled from a distance.

Mr. De La Beche, after having described the various facts which exist in many parts of Britain, indicating the transportation of rock, stones and sand, comes to the following conclusion: The probability, therefore, as far as the above facts seem to warrant, is that a body

of water has proceeded from north to south over the British Isles, moving with sufficient velocity to transport fragments of rock from Norway to the Shetland Isles, and the eastern coast of England; the course of such a body of water having been modified and obstructed among the valleys, hills and mountains which it encounters; so that various minor and low currents having been produced, the distribution of detritus has been in various directions.

If the supposition of a mass of water having passed over Britain be founded on probability, the evidences of such a passage, or passages, should be found in the neighboring continent of Europe, and the general direction of the transported substances should be the same. Now this is precisely what we do find. In Sweden and Russia large blocks of rock occur out of place, in great numbers, and no doubt can be entertained that they have been transported southward from the north.

The same phenomena are observed in Germany, the Netherlands, and indeed in nearly every part of the world where observations have been made. The lower parts of the last named countries contain huge blocks of trans-

ported rock, which are proved by their mineralogical characters to have been derived from the northern regions.

A question of importance now presents itself with respect to the general changes which were produced on the surface of the earth by this moving mass of waters. Did the valleys exist as they do now? De Luc, Von Bush, Beaumont, and several other geologists of the first class, have presented the world with a detail of facts, from which they all infer that the great valleys on the globe existed previously to the catastrophe which tore the rocks from the Alps and scattered them on either side of that chain of mountains.

In this country similar phenomena almost everywhere present themselves to the eye of the observer. Beds of water-worn pebbles, such as are now found only on the borders of the sea, and immense blocks of granite lying in situations to which it is evident they must have been transported, and where no causes now in operation could possibly have placed them, are not uncommon occurrences.

Boulders of various sizes are seen in many places. In East Lynn, Ct., near the road lead-

ing from Rope Ferry to Saybrook, at a location called Keeney's Hill, there is a huge block of granite weighing, by estimate, nearly four hundred tons. Any person, after a moment's consideration, would conclude that this rock must have been transported from a distance, for its present situation is in an open field, on or near the summit of a considerable hill, there being no rocks of the same, or of any kind, on the surface near it. On examining the neighborhood, however, the inquirer will soon find that it came from a granite hill of small elevation, situated about two miles in a north-west direction, and therefore must have been moved towards the south-west, and this is confirmed by the direction of the hill on which the rock stands, and of the valley below. The erratic rocks of Europe have all been moved in the same direction.

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The conclusion, says he, to which I have

been irresistably forced by an examination of this stratum in Massachusetts, is, that all the diluvium which had been previously accumulated by various agencies has been modified by a powerful deluge, sweeping from the north and north-west, over every part of the State, not excepting the highest mountains; and that since that deluge, none but alluvial agencies have been operating to change the surface.

The boulders found in Plymouth and Barnstable consist of a very large number of boulders of primary rocks. These boulders consist chiefly of granite, sienite and gneiss, with occasional masses of gray wacke conglomerate, common feldspar and porphyry. They all correspond with the rocks found along that coast, in the vicinity of Boston and Cape Ann; and no one, it appears to me, can see the marks of degradation along the coast, who will not be convinced that a large portion of the boulders of Plymouth and Barnstable counties come from thence. Some of the boulders are from ten to twenty and even thirty feet in diameter.

Another class of effects from which Professor Hitchcock not only concludes that a

mighty current of water once swept over the surface of Massachusetts, but from which he also infers its direction, is the existence of grooves, furrows, and scratches upon the surface of the rocks that have never been moved from their places. The direction of these grooves is nearly north and south; and this is their general course in every part of the State east of Hoosac mountain.

Mr. De La Beche, after having described the various facts which exist in many parts of Britain, indicating the transportation of rocks, stones and sand, comes to the following conclusions: The evidence, therefore, as far as facts seem to warrant, is, that a body of water has proceeded from north to south, over the British Isles, moving with sufficient velocity to transport fragments of rock from Norway to the Shetland Isles and the eastern coast of England; the course of such a body of water having been modified and obstructed among the valleys, hills and mountains, which it encountered, so that various minor and low currents having been produced, the distribution of detritus has been in various directions.

If the supposition of a mass of waters hav-

ing passed over Britain be founded on probability, the evidences of such passage or passages should be found in the neighboring continent of Europe, and the general direction of the transported substances should be the same.

Now this is precisely what we do find: In Sweden and Russia large blocks of rock occur out of place in great numbers, and no doubt can be entertained that they have been transported southward from the north. The same phenomena are observed in Germany, the Netherlands, and indeed in nearly every part of the old world where observations have been made.

The lower parts of the last named countries contain huge blocks of transported rock, which are proved by their mineralogical characters to have been derived from the northern regions.

A question now presents itself with respect to the general changes which were produced on the surface of the earth by this moving mass of waters. Did the valleys exist as they do now when this deluge begun, or were they formed by its action? De Lue, Von Bush,

Beaumont, and several other geologists of the first class, have presented the world with a detail of facta, from which they all infer that the great valleys existed previously to the catastrophe which tore the rocks from their native beds and scattered them over the country. From the facts and circumstances thus thrown together there is sufficient evidence that the earth has been deluged by a flood of water over the whole circle of the globe, which in its course transported great masses of rock from one place to another, excavated small valleys and filled up others. We have reason to suppose that the great valleys existed before the flood and that the waters covered the highest mountains, and finally left its effects on all sides of the globe.

WORKS OF NATURE.

MOUNTAIN SLIDES.

Instances have happened in various parts of the world, where considerable changes have been produced in the surface of the globe, by the sliding of large portions of earth, together with fragments of rocks, from the declivities of mountains. These changes are readily distinguished from those occasioned by the general deluge, not only by their local and more recent appearance, but also by the direction in which these precipitated rocks remain with respect to the range of the mountain from which they have fallen. For the great currents of the deluge left their effect in lines corresponding with the ranges of most of the high mountains and considerable valleys, where they are still to be seen; whereas occasional slides leave their effects at the feet of the mountains, in piles, or downward ranges.

SLIDE OF THE WHITE MOUNTAINS.

The White Mountains are situated in New

Hampshire, and are the highest land in New England. The slide to be described took place in August, 1826, and was in consequence of the fall of an immense quantity of rain on the mountains.

On both sides of the river Saco, innumerable rocks and stone, many of them of sufficient size to fill a common apartment, were detached, and in their descent swept down before them, in one promiscuous and frightful ruin, forest shrubs and the earth in which they grew. No tradition existed of any similar catastrophe at former times, and the growth of the forests on the flanks of the mountain clearly proved that, at least for a long interval, nothing similar had occurred. One of these moving masses was afterwards found to have slid three miles, consisting of rocks, earth, trees, &c., with an average breadth of a quarter of a mile. The excavations commenced generally in a trench a few yards in depth, and a few rods in width, and descended the mountain, widening and deepening until they became vast chasms. Forests of spruce and hemlock were apparently prostrated with as much ease as if they had been fields of

grain. The valleys of the rivers Amunoosuck and Saco presented for many miles an uninterrupted scene of desolation; all the bridges being carried away and the ground strewed with the wrecks of trees and rocks, and in many instances large quantities of soil. In some places the road was excavated to the depth of 15 or 20 feet; in others it was covered with rocks, trees and soil to as great a height. In various places, as shown by the remaining marks, the water rose to 25 feet above its ordinary level.

But these things are of little consequence when compared with the human suffering which this catastrophe occasioned, for a family of nine persons were destroyed on the night of the 28th, and not one lived to relate the circumstances.

This family, named Willey, occupied a house at the foot of the mountain, a most lonely place, six miles from any other human habitation. It was a resting place for travelers. On the morning of the 28th the house was found standing, but not a human being was there. In the course of a few days seven out of the nine bodies were found at a short

distance below the house, buried under the ruins of the mountain, and most of them shockingly mangled. It appeared that one of the heaviest slides from the top of the mountain had rushed in the most impetuous manner towards the house, but when within six feet of it, it had divided and passed on each side, leaving the house untouched, but sweeping away the stables and horses. At this time it is supposed that the family left the house, and met their destruction; had they remained, all would have been safe.

FLOOD IN THE VALLEY OF BAGNES, IN 1818.

The Valley of Bagnes forms a part of the main valley of the Rhone, above the lake of Geneva, in Switzerland. Through this valley passes the river Dranse, which falls into the Rhone above the lake. In 1818, in consequence of the fall of avalanches, the Dranse was completely damned up, so that a barrier of ice remained across its channel, until the melting of the snow in the spring, formed a lake in its bed, a mile and a half in length, about seven hundred feet wide, and in some places two hundred feet deep. To prevent the consequences apprehended from the sud-

den bursting of this barrier, the people cut a tunnel through it, several hundred feet in length, before the water had risen to any considerable height. When the water had accumulated so as to reach this tunnel, or gallery, it ran through, and melting the ice it drained off about one half the lake. But at length, on the approach of the hot season, the central portion of the remaining mass of ice gave way with a tremendous crash, and the residue of the lake was emptied in half an hour. In the course of its descent, the water encountered several narrow gorges, and at each of these it rose to a great height, and then bursting its barriers, rushed forward with increased violence, sweeping along rocks, houses, trees, bridges, and cultivated lands. For the greater part of its course, the flood resembled a moving mass of rocks and mud, rather than of water. Some fragments of primary rock of enormous magnitude, and which from their dimensions might be compared, without exaggeration, to houses, were torn out of a more ancient alluvion, and borne down for a quarter of a mile. The velocity of the water in the first part of its course was thirty-three feet

per second, which diminished to six feet before it reached the lake of Geneva, where it arrived in six hours, the distance being forty-five miles.

This flood left behind it, on the plains of Martigny, thousands of trees torn up by the roots, together with the fragments of many buildings. Some of the houses in the town of Martigny were filled with mud up to the second story. After expanding in the plain, where the town stands, it passed into the Rhone, and did no further damage. Many lives were destroyed by this flood, and the bodies of several persons were found on the surface of the Geneva lake, thirty miles from the place where they were swept away.

Inundations precisely similar, and from the same cause, are recorded to have happened in former periods. In 1595 the town of Martigny was destroyed by such a flood, and from sixty to eighty persons perished; and in a similar catastrophe which took place fifty years before, one hundred and forty persons lost their lives.

For several months after the debacle just described, the river Dranse having no settled

channel, shifted its position continually from one side to the other of the valley, carrying away newly erected bridges, undermining houses, and continuing to be charged with as large a quantity of earthy matter as the fluid could hold in suspension.

BATHS OF SAN VIGNONE.

This spring is in Tuscany, and affords a striking example of the rapid precipitation of carbonate of lime from thermal waters. The spring issues from near the summit of a hill about one hundred feet high. The water is hot, but Mr. Lyell, from whom this account is taken, does not give its temperature.

So rapid is the deposition from this water, that a pipe leading from the spring to the baths, and inclined at an angle of thirty degrees, is found to contain a coat of solid limestone half a foot thick every year. A mass of solid rock below the hill, formed by this water, is two hundred feet thick. This is employed as a building stone, and in quarrying it, Roman remains of art, such as tiles, have been found five or six feet below the surface, being covered by the deposit.

BATHS OF SAN FILIPPO.

These baths are situated only a few miles from those already described. The waters which supply them are impregnated with carbonate of lime and sulphate of lime, (gypsum.) They flow from a spring immediately into a pond where in twenty years a solid rock is deposited thirty feet thick. A curious manufactory which produces medallions in *basso-relievo* is carried on at this place.

The water is first allowed to stand in a cistern where the sulphate of lime is deposited. It is then conveyed to a chamber through a tube, from the end of which it falls ten or twelve feet, the current being broken by numerous small sticks crossing each other, and by which means the spray is dispersed around the room. Here are placed the moulds of the medallions to be formed, which are first rubbed over with a little soap. The water striking on these moulds leaves particles of carbonate of lime, which, gradually increasing, leaves exact and beautifully white casts of their figures.

SPRINGS OF ST. MICHAEL.

The hot springs of St. Michael, one of the

Azores, have been long celebrated. These waters rise from among volcanic rocks, and hold large quantities of silex in solution. As the waters descend from the fountain, they deposite their silex in the form of what is termed *silicious sinter*, which may be considered as answering to the travertine, or tufa, of calcareous springs.

The herbage and leaves along the course of the stream are more or less encrusted with silex, and exhibit all the successive steps of petrifaction, from a soft state to a complete conversion into stone. Branches of ferns, such as now grow in the vicinity, are thus changed, still preserving their appearance of vegetation, except that they have acquired an ash grey color.

DESTROYING EFFECTS OF THE SEA.

Mr. Lyell has adduced many instances of the power of the sea waves to move large masses of solid rock. In the Shetland Isles this effect has been quite surprising. In 1818, during a storm, a mass of granite, nine feet by six, was thrown by the waves up a declivity to the distance of 150 feet; and, in the winter

of 1802, a mass of rock eight feet by seven, and five feet thick, was moved to the distance of ninety feet by the same force.

The reader, who remembers the immense power which velocity gives a sea wave, as above illustrated, will be at no loss to comprehend why the strongest ships are sometimes reduced to fragments in a few minutes; nor will he wonder at the destroying effects which a wide ocean must produce on a coast which is not guarded by a strong barrier of solid rocks.

DESTRUCTION OF THE VILLAGE OF MATHERS.

The village of Mathers, on the coast of Scotland, was destroyed by an inroad of the sea, in 1795. This town was guarded by a barrier of limestone rock next the shore, but during a storm the waves of the ocean broke through this barrier, and in one night destroyed and swept away the whole village. The sea penetrated 150 yards inland, where it has maintained its ground ever since.

EASTERN COASTS OF ENGLAND.

The eastern coasts of England are constantly suffering from the inroads of the sea. On the

old maps of Yorkshire, many spots are marked as the sites of towns which are now sand-banks in the ocean. A greater or less portion of the coasts of Norfolk and Suffolk are every year swallowed up by the sea. The town of Sherringham, on this coast, exhibits a melancholy proof of this fact. With respect to this town, Mr. Lyell states, that at one point there is a new depth of water of 25 feet, (sufficient to float a frigate,) where only 48 years ago there stood a cliff fifty feet high, with houses upon it. Further to the south are cliffs more than 200 feet high, more or less of which are every year precipitated into the ocean, in consequence of being undermined by the waves. The whole site of the ancient town of Cromer now forms a part of the bed of the German ocean, the inhabitants having gradually pulled down their houses and removed inland as the sea encroached upon them; and, from their present situation, they are in danger of being dislodged by the same cause. From this neighborhood, in the year 1822, a mass of earth and rocks was precipitated into the sea, to the extent of twelve acres, the cliffs being 250 feet high; and on the same coast, three ancient

villages, several manors, and large portions of a number of parishes have from the same cause gradually disappeared and been replaced by the ocean.

Since the time of Edward the Confessor, as appears by the records, the sea-coast town of Dunwich has lost in succession a monastery at one time; at another several churches; at another 400 houses; and subsequently another church, the town hall and jail, together with many other buildings, all precipitated into the sea.

These are given as specimens of the devastating effects of the sea in different parts of the world, and by which it appears that if on the one hand large tracts of coast are forming and encroaching upon the ocean in one part of the world, as in the Baltic and on the coasts of Italy, so on the other hand the sea is encroaching on the land in other parts, probably to an equal extent.

In many instances inundations from the sea have been the means of affecting not only great changes in the surface of the earth in a short period of time, but also of destroying vast numbers of human beings. On the coast

of Holland these disasters have been peculiarly destructive, as well as on the coast opposite.

A considerable peninsula which lay between Groningen and East Friesland, and was thickly inhabited, was partly overwhelmed in 1277, and a considerable portion of the land carried away with many houses and inhabitants. During the fifteenth century other portions were destroyed from the same cause, and a part of the town of Forum, a place of considerable size, was swept away. In 1507, not only the remainder of Forum was engulfed, in spite of the erection of dams, but also several market towns, villages and monasteries were entirely destroyed, together with their inhabitants.

Further to the north, anciently lay the district of North Friesland. This was a peninsula; but in 1240, the sea destroyed the land next the coast, and thus formed an island called Northstrand. This island was originally of considerable extent, but the sea from time to time swept away small portions of it, until the inhabitants became so concentrated that when the island was only four geographical miles in circumference their number was

still nine thousand. At last, on the night of the 11th of October, 1634, a flood from the sea swept over the whole island and destroyed at once a great proportion of the inhabitants, all the houses, churches and cattle, carrying away even the land that had sustained them. By this dreadful calamity there was swept away 1,300 houses, with all the churches, 50,000 head of cattle, and more than 6,000 people.

We might continue these accounts with regard to the changes which have taken place on the same coasts to great length; but our design being chiefly to give examples, rather than general details, we will here conclude this part of our subject.

DOWNS, OR SAND HILLS.

In some sections of our country the fine sand that is thrown up by the sea is carried by the wind to considerable distances, and in such quantities as to cover the land entirely, and to fill up lakes and estuaries. Occasionally, also, there are sand plains at a distance from the sea, where vegetation seems never to have taken root, and where, consequently, there is nothing to prevent the sand from spreading in all directions by the force of the winds.

On the coasts of France and Holland, long chains of sand hills have been formed from the sea, which have effected important geological changes, by barring up the mouths of rivers and bays, and thus preventing the ingress of tides, and changing the course of currents.

On the north coast of Cornwall, in England, a considerable extent of country has been inundated by drifting sand and pulverized shells from the sea shore. Some of the hills thus

formed are several hundred feet high. By the shifting of these sands, the ruins of several ancient buildings have been discovered, showing that these changes have been in progress for many centuries. In some places this sand has become so compact as to be employed for architectural purposes, the cementing agent being oxide of iron, which the water carries, in solution, from the upper to the lower strata.

But it is in the East, and especially on the borders of Egypt, that the devastating effects of sand has produced the most calamitous consequences. In Egypt these are called sand floods. They come from the deserts of Sahara west of the Lybian mountains, and are driven by the west winds through the openings of the mountains. These sands have left no lands capable of tillage on any parts of the western banks of the Nile, not sheltered by mountains. The encroachment of these sands on districts which were formerly inhabited and cultivated, is evidently seen. M. Denon informs us, in his "Travels in Lower and Upper Egypt," that summits of the ruins of ancient cities, buried under these sands, still appear externally; and that but for a ridge of mountains, called the

Lybian chain, which borders the left bank of the Nile, and forms in the parts where it rises a barrier against the invasion of these sands, the shores of the river on that side would long since have ceased to be habitable. "Nothing can be more melancholy," says Denon, "than to walk over villages swallowed up by the sand of the desert, to trample under foot their roofs, to strike against the summits of their minarets, to reflect that yonder were cultivated fields, that there grew trees, that here were even the dwellings of men, and that all have vanished."

De Luc draws an argument from these sand floods in favor of the newness of the earth, and of the truth of the Mosaic history of the creation.

"If then," he continues, "our continents were as ancient as has been pretended, no traces of the habitation of men would appear on any part of the western bank of the Nile, which is exposed to this scourge of the sands of the desert. The existence, therefore, of such monuments, attests the successive progress of the encroachment of the sand, and these parts of the bank, formerly inhabited, will forever remain arid and waste."

"It is, therefore, not solely to her revolutions and changes of sovereigns, that Egypt owes the loss of her ancient splendor; it is also to her having been thus irrecoverably deprived of a tract of land, by which, before the sands of the desert had covered it and caused it to disappear, her wants had been abundantly supplied. Now, if we fix our attention on this fact, and reflect on the consequences which would have attended it if thousands, or only some hundreds of centuries had elapsed since our continents first existed above the level of the sea, does it not evidently appear that all the country on the west of the Nile would have been buried under this sand before the erection of the cities of ancient Egypt, how remote soever that period may be supposed, and that in a country so long afflicted with sterility, no idea would even have been formed of constructing such vast and numerous edifices? When these cities, indeed, were built, another cause concurred in favoring their prosperity. The navigation of the Red Sea was not then attended with any danger on the coasts; all its ports, now nearly blocked up with wreaths of coral,

had a safe and easy access; the vessels laden with merchandize and provisions could enter them and depart without risk of being wrecked on these shoals, which have risen since that time, and are still increasing in extent." "Thus the reefs of coral which have been raised in the Red Sea, on the east of Egypt, and the sands of the desert which invade it on the west, concur in attesting this truth: That our continents are not of a more remote antiquity than has been assigned to them by the sacred historian in the Book of Genesis, from the great era of the deluge."

FORMATION OF CORAL ISLANDS.

It is but recently that any observations tending to interest or inform the naturalist, have been made on the production of the Coral Islands. But the great extent to which these islands have been formed, together with the rapidity with which it has been said they are increasing, give this subject a considerable degree of interest, not only in respect to geology, but also as it regards commerce.

On this subject Dr. Macculloch says: "The production of the Coral Islands of the great Pacific ocean, which endanger this navigation and that of the Indian Archipelago, are tending fast to destroy that of the Red Sea, is a fact completely distinguished from all other subjects of geological investigation. It also forms a most interesting branch of the present inquiries; and it is the more indispensable to examine it, because it has hitherto been unaccountably neglected by other geological writers."

"It is sufficient here," he continues, "to speak in the most general terms of a tribe of animals, for whose description works on zoology must be consulted. In a popular view, a coral is a calcareous structure, inhabited by numerous small animals or polypi; and each form of coral possesses its own species. Each, therefore, forms a sort of colony, the inhabitants of which are disposed in minute cells, which they construct themselves, thus producing the general structure, by their joint labors, as if all were actuated by one design and one mind."

"This is the obvious appearance. But in reality the entire coral plant is one animal. A continuous animal structure pervades the whole, and the calcareous matter, in whatever form, must be viewed as the shell, being a secretion, or deposition of earth in its substance."

The coral insects, of which there are many species, belong to the class of Polypi and order *Coralliferi*, of Cuvier. They are a singular and curious tribe of animals, some of which are too minute to be examined by the naked eye.

The Coralliferi constitute that numerous suit of species which were formerly considered as marine plants, and of which the individuals are in fact united in great numbers to constitute compound animals, mostly fixed like plants; either forming a stem or simple expansion, by means of a solid internal substance. The individual animals are all connected by a common body, and are nourished in common, so that what is eaten by one goes to the nourishment of the general body of all the other polypi.

The common coarse white coral, full of pores, may be considered as an aggregate of the shells, or habitations of one family of these animals. On inspecting a piece of this substance while growing, or building under water, when these animals are at work, small whitish protuberances may be seen projecting from these pores, which being touched, or on removing the coral from the water, are seen to contract and disappear, but re-appear again when the coral is returned to the water. These are the animals which construct the coarse coral only. Those which build the compact kinds, as the red, white and black,

and which, (particularly the red,) are so much valued for ornamental purposes, are of a different species from these, and are so exceedingly minute as to be of difficult detection.

Many species of this tribe are free, and swim with the current, but those which produce the mighty effects about to be described are fixed in their cells.

The islands south of the equator, between the West Coast of America and New Holland, crowding the whole of that sea, under a rapid increase, accompanied by still more numerous rocks, destined perhaps to become the seats of vegetation, and the habitations of man; perhaps at length to form a continent in the Pacific Ocean. To these, abounding particularly between New Holland, New Caledonia, and New Guinea, I may add those of the Indian Archipelago, including Cosmoledo, Chagos, Juan de Nova, Armante, Cocos, and the Maldive and Laccadive Islands.

When we consider the feebleness of the means, and the minuteness of the agents, the extent of these reefs and islands is a subject of equal curiosity and surprise. Among these, Tongataboo is sixty miles in circumference,

and is elevated ten feet above the water. But this is but an insignificant work, when compared with the great coral reef on the eastern coast of New Holland, which extends in an uninterrupted course the distance of three hundred and fifty miles. This, together with several islands of the same, form a continuous line of one thousand miles or more in length, varying from twenty to sixty miles in breadth. To form a just conception of such a production we should imagine it exposed from the foundation. It is a mountain ridge, which bears comparison with many of the larger tracts of terrestial limestone in height; the soundings in that sea being generally from 1,000 to 1,500 feet deep; and with respect to extent of range, it would far exceed any limestone formation known.

But though we may be astonished at the vast productions of these diminutive animals, it is their instinct which ought still more to interest and surprise us. For, when we remember that in many other instances, numbers do compensate for individual weakness, and that there are myriads of millions of these constantly at work, our astonishment rather

arises from a consideration of their numbers than the amount of their labors. And here we cannot but admire the beneficence of the Creator in having given the pleasure of existence to such hosts of instinctive beings, and though buried in the depths of the ocean, their enjoyments are not less than if watched by the inquisitive eye of man.

From the very low order of these animals in the scale of being, we should have little reason to expect they would exhibit any evident signs of intelligence; and yet as in other cases, we can here trace the most positive marks of design in the Great First Cause, in the adaptation of the means to the end proposed.

These animals cannot work above the water, and as they chiefly inhabit an ocean where the wind constantly blows from one quarter, they raise their structure in a perpendicular direction on the windward side, so that when they come near the surface of the water, where the rolling of the sea would a part of the time leave them naked, the waves are thus broken and they can continue their labors to the leeward. The effect of this arrangement is the

erection of a barrier on the one side, so that these little animals can work with facility and comfort on the other, and under similar circumstances, all the reasoning and experience of man would have answered no better purpose than the instinct of these little worms.

After the windward side has been protected, the next part raised to the surface is at some distance to the leeward. The whole when first seen consists of a chain of detached rocks usually placed in a circular form, including an area of various dimensions, but often of several hundred feet in diameter. In the progress of the work, the intermediate parts, whether circular or straight, are gradually filled up, so that on the outside the walls are perpendicular and the water deep, but within the water grows deeper from the margin towards the centre, producing a solid mass of rock, the upper part of which is in the form of a basin. This cavity is at first a kind of salt lake, but is gradually filled up by the labors of the animals, until finally the sea is so far excluded that during calm weather the rain freshens the water in it, and thus at once ends the labors and lives of these industrious creatures.

In process of time when these animals continue their work around such a basin, so as to prevent the sea from dashing into it, and the rain has washed away all the salt, it becomes a pond of fresh water, forming a supply perhaps for the otherwise perishing mariner who happens to be wrecked on these bold shores. And this undoubtedly is but a part of that beneficent design and foresight, for which such myriads of these animals were brought into life.

The highest parts of these reefs being towards the wind,—at certain seasons of the year when the tides are low, these parts will be exposed to the force of the waves, which will break off the most slender parts and wash them to leeward where the animals are still at work, and by whom these fragments are wedded to the principal mass. In this manner an island is raised permanently above the water, and by a continuance of the same process considerable islands are gradually elevated above high water mark in the midst of the ocean.

It is not difficult to imagine how such islands may be clothed with vegetation. The

seeds of plants are known to float thousands of miles, and still retain their vegetative powers. Such seeds taking root in the crevices of these rocks produce plants, which by their annual decay, together with the decomposed coral, soon form a soil fit for others. These in their turn decay, and in that warm climate where the vegetation is luxuriant, there is formed in a few years a soil fit for shrubs and trees.

Many of these islands are only four or five feet above high water mark; and it is apparent that the mode of formation above described would require many centuries to elevate them to any considerable height. Indeed, it is not probable that the parts near the shore would ever acquire any additional elevation, since occasional high tides would carry away the vegetable matter deposited there. But as some of these islands are far above the level of the sea, we must look for some other cause of elevation besides the waters of the ocean and the decay of vegetation. Tongataboo is ten feet above high water at the water's edge, and even this is higher than can be accounted for from the causes described. But

this is a slight elevation when compared with that of many others, for one of the Tonga islands, formed entirely of coral, is in some parts more than 300 feet high. It is hardly necessary to remark that this elevation cannot be accounted for by supposing a depression of the ocean, since this cause would have given all the other islands in that sea a similar height, and besides, it is well known that the sea has not materially changed its level for the last 2,000 years. We must therefore attribute the elevation of these islands to some force acting beneath them; and as we are unacquainted with any power equal to such an effect except that of volcanoes, so there can be little doubt but the force of submarine fire was the active cause of their elevation. One of these islands, indeed, contains a volcano always on fire.

EFFECTS OF THE RIVER PO.

The Po affords a grand example of the manner in which a great and rapid stream bears down to the sea the alluvial matter poured into it by a multitude of tributaries, descending from lofty chains of mountains. The changes gradually produced by this river in the great plains of Northern Italy since the time of the Roman republic have been exceedingly disastrous to some parts of that country. Extensive lakes and marshes have been slowly filled up, as those of Placentia, Parma and Cremona, while others have been drained by the same cause. Since 1390 the Po deserted its bed through a part of the territory of Cremona and invaded that of Parma, its old channel being still obvious, and retaining the name of *Po morto*, or dead Po. The town of Bressello, which formerly stood on the left bank of the river, now stands on the right, the river, not the town, having changed its locality. In the ancient parish records it is stated that sev-

eral churches were taken down and afterwards rebuilt at a greater distance from the new bed of this devastating stream, and in 1471 the friars of a monastery pulled down their edifice and erected it at a greater distance from the Po.

To keep this wild stream within bounds a general system of embankment through the plains of Northern Italy was commenced in the thirteenth century, which has continually been increased until the present time. The increased velocity of the river in consequence of its being thus confined, causes it to transport to the sea a much greater quantity of alluvial matter than it would otherwise do, because there are no sluggish intervals where its waters can deposit their sediment. Hence the delta of the Po, even since the memory of man, has greatly increased. The ancient city of Adria was originally a sea port of the Adriatic sea, but is now twenty miles from the sea.

But notwithstanding more alluvial matter is carried into the sea in consequence of this embankment, more is also deposited in its bed; for that which would be spread upon the plains during an overflow is now confined

within the narrow limits of its banks. In consequence of this constant deposition, it is found necessary every year to remove the mud and sand from the bed of the river, and place it on the embankment, otherwise the water would be in danger of breaking through and destroying the whole plain below.

This system has been so long continued that at the present day, the Po crosses its plains to a considerable distance on the top of a high and continued mound like the waters of an aqueduct, and to the great hazard and terror of the people in the valleys every spring.

M. de Prony, who has recently been employed by government to examine the present condition of this river, and if possible to suggest some method of security against a catastrophe which every year threatens the lives and property of so many inhabitants, ascertained that the bed of the Po is now higher than the roofs of the houses in the city of Ferrara, near which it runs. The magnitude of these barriers, already so immense, it is found necessary to increase every year to prevent an inundation.

When we consider that the smallest stream

breaking through or running over this embankment, would, if not discovered within a few seconds, destroy in spite of all human power, many cities, towns and villages, with all their inhabitants, we may in some degree conceive of the constant anxiety which those must feel who reside within the danger.

DELTA OF RIVERS.

DELTA OF THE PO IN THE ADRIATIC.

We have already described the effects which the Po has produced and is now producing in some parts of the country through which it passes. But we must notice more particularly the changes which this mighty torrent, assisted by the Adige, has produced at its delta in the Adriatic.

These two rivers, with numerous smaller streams, drain some of the loftiest ridges of the Apennines, together with one side of the great Crescent of the Alps. The combined influence of these rivers have produced an enormous increase of alluvial matter along the coast of that sea. From the northernmost point of the gulf of Trieste, where the river Isonzo enters, down to the south of Ravenna, there is an uninterrupted series of recent alluvial deposits, forming dry land more than one hundred miles in length, and from two to twenty miles in breadth. There is evidence

that this great alluvion has been formed within the last two thousand years. Adria, a city which gave name to the Adriatic, was originally a sea-port; it is now twenty miles from the sea. Ravenna and Spina were also built on the sea, but, at the present time, the first is four, and the last ten or twelve miles from the water.

DELTA OF THE RHONE.

The advance of the delta of the Rhone into the sea is proved by many circumstances, and particularly by the fact that an island in the ocean described by Pomponius Mela, an ancient Latin geographer, is now far inland; and that a location which was a harbor in 898, is now three miles from the shore. It is also known that Psamodi, which was an island in 815, is at the present time six miles from the sea.

DELTA OF THE GANGES.

The Ganges and the Burrampooter descend from Himmala mountains, the most lofty on the globe. The latter river may be considered as a branch of the former, and falls into it long before their united waters reach the sea. The Ganges is discharged into the bay of

Bengal, which forms a vast indenture into the continent of more than two hundred miles in length. The Delta of the Ganges commences more than 200 miles from the Bay of Bengal in a direct line, and 300 if the distance be estimated along the windings of the river. That part of the Delta which borders on the sea, is divided by a vast number of rivers, or creeks, all of which are salt except those which communicate with the principal arms of the Ganges. The tract is famous under the name of *Sunderbunds*, being the common haunt of tigers and alligators. Its extent, according to the account of Major Rennell, is equal to the whole principality of Wales. Its base, bordering on the sea, is about two hundred miles in length, and on each side it is enclosed by an arm of the Ganges. Besides these, through which the water of this immense river is now discharged, there are six other great openings through the Delta into the sea, each of which has evidently, at some ancient period, been the principal bed of the river. During the period of overflow the greater part of this vast Delta is covered with the water of the river, so that the Ganges appears to be flowing into a vast

lake, instead of itself inundating, and sweeping a whole territory of India. So great is the quantity of mud and sand carried down by this immense current, at such seasons, and so vast the quantity of water it discharges, that the ocean is discolored by it to the distance of sixty miles from its mouth.

In various parts of this delta great accumulations, or islands, are formed in the course of a few years, and perhaps as soon swept away, and similar ones formed in other places. Some of these, which are islands during freshets, Major Rennell states, are equal in extent to the Isle of Wight, and thickly inhabited. The people are, however, always in danger of being swept away by floods of uncommon height. In 1763 such an inundation happened, the water rising six feet above ordinary floods; and consequently the inhabitants of one of these districts of considerable extent were, with their horses and cattle, totally engulfed and perished in the water.

These examples of the effects of running water in changing the surface of the globe are sufficient to show that changes in all parts of the world are constantly taking place to a greater or less extent.

The aggregate accumulation of solid ground by the formation and extension of deltas on the surface of the whole earth, must be very considerable during every year; and yet these effects are hardly appreciable in relation to the changes they produce on the entire surface of the globe. It is true, that the course of navigation is in a few instances obstructed or changed by these accumulations, but in general the same sea-ports of which the earliest records of history give any account, are still accessible.

GEOGRAPHY OF VOLCANOES.

The changes produced by earthquakes are often as sudden as they are calamitous and fearful, sometimes in a single hour or even in a moment, not only reducing to fragments the most solid and costly monuments of man, but also mutilating the face of the earth itself——tearing down mountains—elevating islands in the depths of the ocean, or burying whole territories under inundations of liquid fire.

It is a striking circumstance in the history of volcanoes and earthquakes that these awful exhibitions of nature have hitherto been almost entirely confined to certain regions of country. At present the Andes of South America are among the best defined of these regions. Beginning with Chili, in the 46th degree of south latitude, and proceeding north to the 27th degree of the same latitude, we shall find a line of volcanoes so uninterrupted that hardly a degree is passed without the occurrence of one of these agents in an active

state. About twenty are enumerated within that space, and there is no doubt but many more exist, some of which are dormant and perhaps some have become extinct. How long an interval of rest entitles a volcano to be considered as extinct, is not determined. Those which have always been inactive since the era of history, may perhaps be so considered. The volcano of Ischia, in Italy, was silent for a term of 1700 years, after which it again commenced a series of eruptions.

The volcanoes of Chili have their chimneys pierced through mountains of granite, thus exhibiting the effects of a degree of force, of which man, without the existence of such a phenomena, could have nowhere gained the least conception. Villarcia is one of the principal volcanoes of this district. It is so elevated as to be visible at the distance of 150 miles, and burns without intermission. Every year the inhabitants of this province experience shocks of earthquakes. In 1822, the whole coast of Chili to the extent of 100 miles was elevated several feet by a subterranean convulsion.

Proceeding to the north where the Andes

attain their greatest elevation, we find in the province of Quito, Cotopaxi, Antisana and Pichinca, all of them in an active state and frequently emitting flames. Tunguragua is also in the same district. This mountain, in 1797, threw out a deluge of mud which filled valleys a thousand feet wide and six hundred deep, forming barriers by which rivers were damned up and lakes formed. North of Quito, in the provinces of Pasto and Popyan, occur six other volcanoes; and in the provinces of Guatemala and Nicaragua, which lie between the isthmus of Panama and Mexico, there are no less than twenty-three volcanic mountains, all of them situated between the 10th degree and 15th degree of north latitude, some of which are constantly in an active state.

This great volcanic chain, after being thus extended from south to north, nearly in a direct line, is continued through a great part of Mexico from west to east. Here are five active volcanoes known by the several names of Tuxtla, Oribaza, Popocatepest, Jorullo and Colima. Still north of Mexico, in the peninsula of California, there are at least three, and according to some, five burning mountains.

Thus we see that this volcanic chain extends nearly in an uninterrupted course from Chili to the north of Mexico, a distance of nearly 4,000 miles.

The whole range of mountains from Cape Horn northward through South America, Mexico, United States and the British Possessions in North America, called the Andes and Rocky Mountains, a distance of about 9,000 miles, may be called a volcanic range, probably the longest on the globe.

Another continuous volcanic range, of nearly equal extent, begins at the Aleutian Islands, belonging to Russian America, and by a circuitous route passes to the Molucca Islands. Through this whole extent earthquakes of the most terrific description are common.

But our limits will not permit the enumeration of all the volcanic tracts described by authors. Besides those already mentioned, Kamtschatka has seven burning mountains; the island of Java contains thirty-eight great volcanoes; the Molucca Islands contain several, and among them that of Sumbawa, which, in 1815, suffered one of the most tremendous eruptions recorded in history. The islands of

Jesso and Niphon and Sumatra contain more or less volcanoes; and from the Caspian Sea to the Azores, is a volcanic range. Of Sicily and Italy it is hardly necessary to speak in this enumeration, since the descriptions of Ætna and Vesuvius, of Herculaneum and Pompeii, are well known, and are sufficient to indicate the volcanic disposition of that part of Europe. The West India Islands have occasionally suffured great calamities from this cause; and Iceland contains many burning mountains, among which is Skaptar Jokul, which in 1783 suffered an extraordinary eruption, which we shall describe.

The whole number of volcanoes known is about 200. The forms of volcanic mountains are generally so peculiar as to be distinguished from all others. They are commonly of considerable height and sometimes very lofty. When solitary they are of a conical form and more or less truncated, that is, bearing the appearance of having been cut off at the top. When active, or but recently extinguished, the truncation has within it a cavity of greater or less size, called the *crater*.

The accurate form of a perfect crater is an

inverted conoid, and on Cotopaxi and Teneriffe they are surrounded by walls of lava, but most commonly this part is composed of ashes which have fallen down during eruptions. The size of the crater does not necessarily bear any proportion to that of the mountain. In some mountains both the size and the shape varies with every eruption.

In nearly all instances volcanoes are seated near the sea, or in the vicinity of a large body of water, and it was formerly thought that proximity to the water was absolutely necessary to their action; nor is it certain that this is not the case. The only exception to this general fact is Jorullo, one of the burning mountains of the Andes which is situated more than a hundred miles from the ocean, nor does it appear that any considerable body of water is near it. It has, however, been suggested from some circumstances observed with respect to this mountain, that it may possibly communicate with the sea by a deep fissure.

In many instances volcanoes have thrown out mud or water instead of lava and ashes; and in some instances fish of various kinds have been found in the water thus emitted,

though no previous suspicion had existed, of a communication between the mountain and the sea.

VOLCANIC ERUPTIONS.

The action of most volcanoes is periodical, or intermitting, though this is not the case with all. Vesuvius and Ætna are sometimes dormant for a series of years, but Stromboli, in the vicinity of the former, has been constantly burning ever since two hundred and ninety-two years before the Christian era, being upwards of two thousand years. Jorullo has continued to emit flames ever since 1759, at which time it was elevated from the plain on which it stands. But Vulcano suffered no eruption for eleven centuries, and we have already noticed that Ischia lay dormant for seventeen hundred years.

The appearances which attend volcanic eruptions are various. In some instances flames issue suddenly and silently from the cone, affording only splendid picturesque phenomena. But in others the scene is the most terrific and appalling of which the imagination can conceive. For these descriptions we must,

however, refer to particular eruptions, an account of which will follow.

The eruptions of Vesuvius and Ætna, these mountains being in the midst of a highly cultivated people, are best described. Indeed, from the time of Pliny to the present day, these have been the subjects of interesting and learned dissertations.

In general the first appearance of an eruption consists of a column of smoke rising to a great height, and then spreading out in the form which Pliny compared to that of a pine tree. This is followed by explosions from the craters; by trembling of the earth, or perhaps by its alternate rising and falling; the whole being attended by a rumbling, subterranean sound, forming both an eruption and an earthquake. Flame is then seen to issue from the cone, attended by red hot stones, often thrown to the height of several hundred feet, producing in the night those brilliant and terrific phenomena so often described. During the emission of the black smoke and before the flame issues, there are often the most vivid flashes of lightning, which add greatly to the splendor of the scene. After these phenomena

have existed for a longer or a shorter time, the melted lava rising to the edge of the crater flows over it, and runs down the side of the mountain into the plain below. This is in the form of a torrent of liquid fire, ofter narrow, but sometimes many miles in width. It sometimes proceeds rapidly, but more often slowly, the last portions of lava passing over the first in small cascades. Sometimes, or from some mountains, there is much smoke and but little lava; while from others, or at other times, the crater vomits rivers of melted matter, without smoke or flame.

The eruption of lava is often followed by showers of ashes, which consist of finely divided particles of lava, and which are often wafted by the wind to the distance of several hundred miles.

The quantity of matter ejected by some volcanoes is astonishingly great. Brieslak, an Italian geologist, calculated that the quantity of lava which flowed from a volcano in the island of Bourbon, in 1796, amounted to 45,000,000 of cubic feet; and that the quantity from the same, in 1787, was 60,000,000 of cubic feet; and during one eruption from a

mountain in Iceland, the lava flowed about ninety miles, having a width of at least twenty miles, and in some places a depth of several hundred feet.

We shall describe a few volcanic eruptions, selecting only those which have been the subject of peculiar or scientific interest, or which have produced extraordinary effects, either with respect to the destruction they have caused, or the quantity of lava they have ejected.

ERUPTIONS OF VESUVIUS.

The most ancient eruption of this Italian mountain, of which there is any particular description, was in A. D. 79, at which time the cities of Herculaneum and Pompeii were destroyed. It does not appear that any lava or melted matter was emitted at this eruption; the ejected substances being sand, ashes and mud. But it is certain that this mountain had previously emitted lava, since the streets of these cities are paved with this substance. The first stream of lava of which there is any account was in 1036, being the sixth or seventh eruption on record. From this period all

the eruptions which have taken place are recorded, and many of them described by scientific men at great length.

Some of them produced considerable changes, not only in the form and appearance of the mountain itself, but also of the country in the vicinity. That of 1538, elevated the land along the coast of Naples many feet, destroyed many villages, and produced Monte Nuovo, which is still 440 feet in height. A description of this mountain will be given hereafter.

From about the end of the 18th century to 1822, the great crater of Vesuvius had been filling up gradually, with lava which boiled up from below, so that the bottom of the cavity presented a kind of rocky plain covered with blocks, crags and hillocks of volcanic matter. But during the latter year, in the month of October, the form and appearance of the ancient crater was entirely changed. The explosions at that time were so violent during twenty days, as to break up and throw out the whole of that accumulated mass, leaving an immense gulf or chasm about three miles in circumference, and in some parts 2,000 feet deep. At the same time about 800 feet in

height of the original cone or top of the ancient crater, was carried away by the explosions, so that Vesuvius became reduced in height from about 4,200 to 3,400 feet.

In ascending the mountain, its sloping sides are found to be covered with loose materials intermixed with each other without the slightest order, and just as they fell from the crater. But on arriving at the crater itself the beholder is surprised to find that every thing is there arranged in the most perfect symmetry, and that the materials are disposed in regular undulating strata. These consist of alternate layers, composed of lava, sand-ashes, and scoria, lying in distinct beds, and alternating with each other. These have resulted from the different colors, and coarseness of these materials, and which severally remain in the same situation and succession as they fell from the air during the different eruptions.

In some parts of the crater are seen dykes, or veins of more compact matter intersecting the above described strata. These are on the outside of the cone, and being harder than the volcanic matter through which they have

passed, they have resisted decomposition, and therefore project above the surface.

These have undoubtedly been formed by the filling up of open fissures with liquid matter forced up from below. At what period they were formed is unknown, but if such fissures are formed by the cooling, and consequent shrinking of the crater after an eruption, it is probable that at the next eruption these are filled with the fused matter, so that some of these veins may be formed at every eruption.

In the crater of Vesuvius was left by the eruption ot 1822 a small cone in the bottom of the crater, thrown up in 1828. In the bottom of many craters there are several of these small cones, which are constantly emitting steam or smoke, and sometimes throw up lava.

Immense volumes of steam or aqueous vapor are evolved from the craters of volcanoes during eruptions. These vapors being condensed by the surrounding atmosphere often fall down in torrents of rain. The rain precipitates the volcanic dust from the air, and sweeps that along which had fallen on the declivity of the mountains until a torrent of mud

is produced. Such torrents are as much to be dreaded as the inundations of mud which are sometimes thrown from the volcano, and with the exception of the heat, are more disastrous than burning lava, being much more rapid in their descent. In 1822 one of these mud streams descended from Vesuvius, and after destroying a district of cultivated ground, suddenly flowed into the villages of St. Sebastian and Massa, where, filling the streets and some of the houses, it suffocated seven persons.

DESTRUCTION OF POMPEII AND HERCULANEUM.

These cities were overwhelmed and destroyed in the year A. D. 79, and most probably either by an alluvion of mud, such as we have just described, or by an emission of the same kind of matter from the mouth of the volcano.

It has been supposed that it was by an eruption of lava that these cities were destroyed; but Lippi, an Italian writer, has shown that many facts presented by their ruins are incompatible with this opinion. Thus the casts, or impressions of persons which still remain, especially of a woman found in a vault at Pompeii, cannot be accounted for on the

supposition of flowing melted lava, nor of falling volcanic ashes, for the first would have utterly destroyed the form of the body, and the second could not have reached through the roofs of the buildings.

"There is decisive evidence," says Mr. Lyell, "that no stream of lava ever reached Pompeii since it was first built, although the foundations of the town stand upon the old lava of Mount Somma, several streams of which have been cut through in making excavations. At Herculaneum the case is different, although the substance which fills the interior of the houses and vaults must have been introduced in a state of mud, like that found in similar situations in Pompeii; the superincumbent strata differ wholly in composition and thickness. Herculaneum was situated several miles nearer to the volcano, and has therefore been always more exposed, to be covered not only by showers of ashes, but by alluvions and streams of lava. Accordingly, masses of both have accumulated on each other *above* the city, to a depth of nowhere less than seventy, and in some places 112 feet. The tuff or mud, which envelops the buildings, consists of com-

minuted volcanic sand mixed with pumice. A mask imbedded in this matter has left a cast, the small lines and angles of which are quite perfect, nor did the mask present the least indications of heat."

These cities were both sea-ports, and Herculaneum is still near the shore, but Pompeii is at some distance from it, the intervening land having been made at various times by volcanic matter.

Herculaneum was discovered 1713, by the accidental circumstance of a well being dug which came directly upon the theatre, where the statues of Hercules and Cleopatra were found. These cites are mentioned by ancient authors as being among the seven flourishing towns of Campania; they were originally settled by Greek colonies.

Both at Herculaneum and Pompeii temples have been found with inscriptions commemorating the event of their rebuilding after having been overthrown by an earthquake. This earthquake happened in the reign of Nero, sixty-three years after the Christian era, and sixteen years before the catastrophe by which they were finally destroyed.

It is supposed that about one-fourth of Pompeii is uncovered, presenting streets, walls, temples, houses, and monuments of art, many of them in the same condition as they were nearly 2,000 years ago. Being covered with a deluge of mud, even the paintings have been preserved, and the wood remains in a perfect state. In some instances the walls of the buildings are rent, probably by the earthquake which happened before the fatal eruption, but the edifices chiefly remain entire.

Circumstances of great interest and curiosity are everywhere indicated among these ruins. Columns have been found lying upon the ground half finished, showing that the workmen were driven from their labors; and the temple for which they were designed remains unfinished. In some places the pavement in the streets has sunk down, but in general it remains entire, consisting of great flags of lava, in which two immense ruts have been worn by the constant passage of wheel carriages. When the hardness of this stone is considered, the continuity of these ruts from one end of the town to the other is not a little remarkable, for there is nothing like it in the oldest pavements of modern cities.

Only a very small number of skeletons have been found in either city, and it is therefore certain that most of the inhabitants had time to escape, and also to take with them most of their valuable effects. In the barracks of Pompeii were the skeletons of two soldiers chained to the stocks; and in the vault of a house in the suburbs were the bones of seventeen persons, who appear to have fled there to escape the shower of ashes. They were found enclosed in indurated tuff or mud, which flowed from the mountain. In this was preserved the cast of a woman, perhaps the mistress of the house, with an infant in her arms. Though her form was impressed in the rock, nothing but her bones remained. To these bones a chain of gold was suspended around the neck, and rings, with precious stones, were found on the finger-bones of the skeleton.

The writings scribbled by the soldiers on the walls of the barracks are still visible; and the names of the owners, over the doors of their houses, are often easily read.

The colors of fresco paintings on the stuccoed walls, in the interior of the buildings, are frequently almost as vivid as if they were

just finished. Some of the public fountains have their pavements decorated with shells, laid out in patterns, still retaining, in all respects, their original condition; and, in the room of a painter, who was, perhaps, also a naturalist, was found a large collection of shells, comprising a great variety of the Mediterranean species. These were in as good a state of preservation as if they had remained the same number of years in a museum.

The wooden beams of the houses at Herculaneum are black on the exterior, but when cleft open, they appear to be nearly in the state of ordinary wood, and the progress made by the whole mass towards the state of lignite, (mineralized wood,) is hardly appreciable. Even small substances of vegetable origin are often found in a state of entire vegetation. Fishing nets are abundant in both cities, and often quite perfect; and in a fruiterer's shop were found vessels full of almonds, chestnuts, and walnuts, all in perfect shape. And what is still more extraordinary, in a baker's shop was discovered bread, with the name of the maker stamped upon the loaf, thus, Eleris Q. Crani Riser. On the counter of an apotheca-

ry was a box of pills, converted into a fine earthy substance, and, by its side, a small cylindrical roll, evidently prepared to be cut into pills.

ERUPTIONS OF ÆTNA.

Ætna appears to have been periodically active from the earliest times of history, for Diodorous Siculus mentions an eruption of it, which caused a district of country to be deserted by its inhabitants before the Trojan war; and Thucydides informs us that between the time when Sicily was colonized by the Greeks and the commencement of the Pelopennesian war, that is, in 431 B. C., there had occurred three eruptions of this mountain.

But, notwithstanding notices of this mountain were recorded thus early, the first eruption which has been particularly described was the great one of 1669. An earthquake, previous to this eruption, had levelled many of the villages and towns in the neighborhood, and at the commencement of which, an extraordinary phenomenon happened in the plain of St. Lio. Here a fissure, six feet wide, and of an unknown depth, opened in the ground, with a loud, terrific, crashing noise, and ran in a tor-

tuous course nearly to the top of Ætna. Its direction was from north to south, and its length twelve miles. This fissure, as it opened, emitted vivid flashes of light. Five other parallel fissures of considerable length, afterwards opened, one after the other, emitting smoke, and giving out the most horrid bellowings, which were heard to the distance of forty miles.

The lava, during this eruption, having overwhelmed and destroyed fourteen towns, some of them containing three or four thousand inhabitants, at length arrived at the walls of Catania, a populous city, situated ten miles from the volcano. These walls had been raised sixty feet high, towards the mountain, in order to protect the city, in case of an eruption. But the burning flood accumulated against the wall so as to fill all the space around and below that part, and finally poured over it in a fiery cataract, destroying everything in that vicinity.

From Catania, the lava continued its course until it reached the sea, a distance of fifteen miles from its source, in a current about 1800 feet broad, and forty feet deep. While mov-

ing on, its surface was, in general, a mass of solid rock, or cooled lava, and it advanced by the protrusion of the melted matter, through this hardened crust.

As an illustration of the intense heat of volcanic matter, the Canon Recupero relates that in 1766, he ascended a small hill, composed of ancient volcanic matter, in order to observe the slow and gradual manner in which a current of liquid fire advanced from Ætna. This current was two and a half miles broad; and, while he stood observing it, two small threads of lava, issuing from a crevice, detached themselves from the main stream, and approached rapidly towards the eminence, where he and his guide were standing. They had only just time to escape, when they saw the hill on which they had stood a few minutes before, and which was fifty feet high, entirely surrounded, and, in about fifteen minutes, entirely melted down into the burning mass, so as to be incorporated with and move on along with it.

VOLCANOES IN ICELAND.

Iceland is both a volcanic country, and a country of volcanoes. A considerable propor-

tion of its surface is covered with ancient or modern lava, and it is now subject to the most dreadful calamities from this source.

With the exception of Ætna and Vesuvius, the most complete chronological records of volcanic eruptions are those of Iceland. From these it is ascertained, that from the 12th century there has never been an interval of more than forty years, and rarely more than twenty, without eruptions and earthquakes in some part of that country. Single eruptions of Mount Hecla have sometimes continued for six years. In many instances the whole island has been convulsed by earthquakes, during which mountains were rent asunder, hills sunk down, and rivers have deserted their former channels.

ERUPTIONS OF SKAPTAR JOKUL IN ICELAND.

In 1788, this volcanic mountain suffered one of the most extraordinary eruptions recorded in history, both with respect to the quantity of lava it threw out, and the calamities it occasioned.

The river Skapta, a considerable stream, was for a time completely dried, by a torrent of

liquid fire from this mountain. This river was about two hundred feet broad, and its banks from four to six hundred feet above the level of the water. This defile was not only entirely filled to a considerable extent by the lava, but it also crossed the river by the dam thus formed, and overflowed the country beyond, where it filled a lake of considerable extent and great depth.

This eruption commenced on the 11th of June, and on the 18th of the same month, a still greater quantity of lava rushed from the mouth of the volcano, and flowed with amazing rapidity, sometimes over the first stream, but generally in a new course. The melted matter having crossed some of the tributary streams of the Skapta, completely dammed up their waters, and caused great destruction of property and lives by their overflow. The lava, after flowing for several days, was precipitated down a tremendous cataract, called Stapafoss, where it filled a profound abyss, which that great waterfall had been excavating for ages, and thence the fiery flood continued its course.

On the third of August, a new eruption

poured forth fresh floods of lava, which taking a different direction from the others, filled the bed of another river, by which a large lake was formed, and much property and many lives destroyed.

The effects of this dreadful calamity may in some measure be imagined when it is known, that although Iceland did not, at that time, contain more than fifty thousand inhabitants, there perished nine thousand human beings by this single eruption, making nearly one in five of the whole population. Part of them were destroyed by the burning lava itself, some by drowning, others by noxious vapors which the lava emitted, and others in consequence of the famine caused by the showers of ashes, which covered a great proportion of the island and destroyed the vegetation. The fish also, on which the inhabitants depended in a great measure for food, entirely deserted the coast.

The quantity of lava which Skaptar Jokul emitted during this eruption was greater than is recorded of any other volcano. The two principal branches or streams of lava flowed chiefly in different directions. The length of the smallest was forty miles, and of the other

fifty miles. The breadth of that branch which filled the Skapta was from twelve to fifteen miles, and the other about seven miles. The ordinary depth of each was about 100 feet but in narrow defiles it was more than 600 feet deep, and in many places from 200 to 300.

Allowing that the united breadth of this vast lava stream was 20 miles, and the whole length 90 miles, then this mountain at a single eruption threw out a quantity of lava which covered a surface of 1800 square miles, an area equal to the fourth part of the State of Connecticut, and nearly one half the size of Rhode Island.

When it is considered that the depth of the whole might average 150 feet, we may go into calculations concerning the quantity of matter thrown out, but we can have no conception of the force required to elevate such a stream of melted rock through the crust of the earth.

GEYSERS OF ICELAND.

But the Geysers of Iceland afford the most remarkable examples of the deposition of silex. These springs are situated in a volcanic district, the surface of the ground out of which they rise being covered with streams of ancient

lava, through the fissures of which steam and hot water are emitted in various places.

The great Geyser, which has excited so much interest, on account of the singular phenomena which it exhibits, rises out of a basin at the summit of a circular mound, composed of silicious incrustations deposited from the spray of its waters. The diameter of this basin or crater is 56 feet in one direction, and 46 in the other.

In the centre of this basin is a natural pipe seventy-eight feet in perpendicular depth, and from eight to ten feet in diameter, gradually widening as it opens into the basin. The basin, as the spring intermits, is sometimes empty, but is more commonly filled with beautifully transparent boiling hot water, which is often in a state of violent ebullition. During the rise of the water up the pipe, especially when the ebullition is most violent, subterranean noises are heard, like the distant firing of cannon, and a slight tremor of the earth is felt near the place. The sound then increases, and the motion of the earth becomes more violent, until at length a column of water is thrown up from the pipe, in a perpendicular

direction, to the height of from one to two hundred feet, attended with loud explosions. This is continued, with interruptions like an artificial fountain, for a few minutes, the water at the same time giving off immense quantities of steam and vapor, when the pipe is evacuated by the discharge of its whole contents of water, and there follows an immense column of steam, which rushes up with amazing force and a loud thundering noise, after which the eruption or paroxysm terminates, and the Geyser becomes quiet.

If stones are thrown into the pipe or crater during an eruption they are instantly ejected, and such is the explosive force of the steam, that masses of hard rock thrown in are returned into the air and shivered into small fragments. Mr. Henderson, late a resident in Iceland, and well acquainted with these phenomena, states that by throwing stones into the pipe of the Geyser, he could bring on an eruption in a few minutes, and that in such cases the fragments of stone as well as the water were thrown much higher than usual. When an eruption had been brought on in this manner, and the water had been ejected, the steam

continued to rush up, with amazing force, and attended by a deafening roar for nearly an hour, but the Geyser, as if exhausted by this effort, did not give symptoms of a fresh eruption when its usual interval had elapsed.

In June, 1759, subterrenean sounds of an alarming kind were heard by the inhabitants of this district, and these were followed by earthquakes, which succeeded each other for two months. In the month of September, flames were seen to issue from fissures in the ground, and from the same place red hot rocks were thrown to an immense height. Soon after six volcanic cones were formed of lava and the fragments of rock, thrown up from the earth, in the same neighborhood. The least of these was three hundred feet in height. In the midst of these cones, rose Jurollo, which was formed in the same manner, and soon rose to the height of 1600 feet by the accumulation of lava and fragments of rock. The small cone ceasing their action, Jorullo became the great outlet of volcanic matter, and continued to emit lava and large fragments of primitive rock for many months. Jorullo has continued to emit flames ever since its formation.

VOLCANO OF SUMBAWA.

Sumbawa is one of the Molucca Islands; and the mountain from which occurred, on some accounts, the most extraordinary volcanic eruption of which any accounts have been recorded, is called Tomboro.

This eruption commenced on the 5th of April, 1815, but was most terrific on the 11th and 12th of that month, nor did it cease entirely until sometime in the following July. The explosions so much resembled the firing of heavy cannon at a distance that the people of many vessels at sea supposed there was a great naval engagement within hearing, but could not imagine what nations were engaged.

The commanders of some ships and of several English forts gave orders to prepare for battle, though they were several hundred miles distant from the mountain. At Sumatra these tremendous explosions were distinctly heard, though not nearer than 900 miles from Tomboro. They were also heard at Ternate, in the opposite direction from Sumatra, at the distance of 720 miles from the mountain.

So immense in quantity was the fall of ashes that at Bima, forty miles from the mountain,

the roof of the English resident's house was crushed by the weight, and many other houses in the same town were rendered uninhabitable from the same cause. At Java, 300 miles distant, the air was so full of ashes that from this cause at mid-day it is said the darkness was so profound that nothing like it had ever before been experienced during the most stormy night.

Along the coast of Sumbawa, the sea was covered with floating lava, intermixed with trees and timber, so that it was difficult for vessels to sail through the mass. Some captains, though at a long distance at sea, mistook this mass for land, and sent out their boats in order to ascertain the safety of their situations. The sea, on this and neighboring coasts rose suddenly to the height of twelve feet, in the form of immense waves, and as they retired swept away trees, timber and houses, with their inhabitants. All the vessels lying near the shore were torn from their anchorings, and cast upon the land. Violent whirlwinds carried into the air men, horses, cattle, trees, and whatever else was in the vicinity of the mountain. Large trees were

torn up by the roots and carried into the sea. But the most calamitous part of the account still remains; for such were the tremendous effects of the burning lava; the overflowing of the sea; the fall of houses, and the violence of the whirlwind, that out of 12,000 inhabitants on this island, only twenty-six individuals escaped with their lives, all the rest being destroyed in one way or another.

The whole island was completely covered with ashes or other volcanic matter. In some places, the bottom of the sea was so elevated as to make shoals where there was deep water before; and in others, the land sunk down and was overflown by the sea.

The details of this awful calamity were collected and published by Sir Stamford Raffles, then Governor of Java, who required all the residents in the various districts under his authority to send him a statement of the circumstances which fell under their several observations.

EARTHQUAKES OF CALABRIA.

"Of the numerous earthquakes," says Mr. Lyell, "which have occurred in different parts of the globe during the last 100 years, that of

Calabria, in 1783, is the only one of which the geologist can be said to have such a circumstantial account, as to enable him fully to appreciate the changes which this cause is capable of producing in the lapse of ages. The shocks began in February, 1783, and lasted nearly four years, to the end of 1786." The importance of the earthquake in question arises from the circumstance that Calabria is the only spot hitherto visited, both during and after the convulsions, by men possessing sufficient leisure, zeal, and scientific information, to enable them to collect and describe with accuracy the physical facts which throw light on geological questions.

Authors who witnessed the phenomena of these convulsions are quite numerous. Among them, it is said that Pignataro, a physician who resided at the centre of the earthquakes, and who kept a register of the number and force of the shocks, is among the most correct. The Royal Academy of Naples also sent a commission from their own body to Calabria, accompanied by artists, with instructions to describe and illustrate by drawings, the effects of these terrible convulsions; and Sir William

Hamilton, who surveyed this district before the shocks had ceased, has added many facts not recorded by others. Our limits will, however, allow only a brief summary of the facts, from these several sources.

The subterranean concussions were felt beyond the confines of Sicily; but if the city of Oppido, in Calabria, be taken as the centre, a circle around it, whose radius is twenty-two miles, would include the space which suffered the greatest calamities. Within this circle, all the towns and villages were almost entirely destroyed.

The first shock, which took place on the 5th of February, 1783, threw down, in the space of two minutes, a greater part of the houses within the whole space above described. The convulsive motion of the earth is said to have resembled the rolling of the sea, and that in many instances it produced swimming of the head, like sea-sickness. This rolling of the surface, like the billows of the sea, was like that which would have been produced by the agitation of a vast mass of liquid matter under the ground.

In some walls which were shattered the sep-

arate stones were parted from the mortar so as to leave an exact mould where they had rested as though the stone had been carefully raised from its bed in a perpendicular direction; but in other instances the mortar was ground to powder between the stones, as though they had been made to revolve on each other.

It was found that the swelling or wave-like motions, and those which were called *vorticose* or whirling, often produced the most singular and unaccountable effects. Thus, in some streets, in the town of Monteleone, every house was thrown down except one, and in some other streets all except two or three, and these were left uninjured, though differing in no respects from the others.

In many cities all the most solid edifices were prostrated, while those which were slightly built escaped; but, in others, it was precisely the reverse, the massive buildings being the only ones that remained standing.

But, perhaps, the most singular effect was that produced on a pair of obelisks, at the convent of St. Bruno, where the different stones composing these monuments were moved on each other in a manner altogether unac-

countable, unless indeed it can be supposed that the earth, where each stood, underwent a rapid gyratory motion. The shock which shook the convent is said to have been of that kind which writers describe by the term vorticose or whirling.

The pedestal of each obelisk remained in its original situation and place; but the separate stones were turned partly around on each other, some of them being moved eight or nine inches out of their place, but none were thrown down.

It appears from the statements that in many instances where the ground was fissured, the motion must have been from below, upwards, for these fissures opened and closed alternately as though the ground, in that particular spot, had been violently lifted up with a force from below, by which a fissure was formed, but the force ceasing instantly the ground again assumed its former position and the fissure closed. Perhaps the escape of some gas or steam through the fissure produced this effect.

In many instances these fissures were so wide as in an instant to swallow up men, trees and even houses, and when the earth sunk

down again, it closed upon them so entirely as not to leave the least vestige of what had happened, nor were any signs of them ever discovered afterwards. In the vicinity of Oppido, the centre of these convulsions, many houses were precipitated into the same great fissure, which immediately closed over them; and, in the same neighborhood, four farm-houses, several oil stores and dwelling-houses were so entirely engulfed that not a vestige of them were seen afterwards.

In some instances these chasms did not close. In one district, a ravine formed in this manner, a mile long, 100 feet broad, and 30 feet deep, remained open; and in another a similar one remained, three-quarters of a mile long, 150 feet wide, and 100 feet deep; in another instance there remained such a chasm 30 feet wide and 225 feet deep.

In various places the ground sunk down and lakes were formed, which being fed by springs have remained ever since. The convulsions also removed immense masses of earth from the sides of steep hills into the valleys below, so that in many instances oaks, olive orchards, vineyards and cultivated fields were seen grow-

ing at the bottoms of deep hollows, having been removed from the side hills of the vicinity. In one instance a mass of earth 200 feet thick and 400 feet in diameter, being set in motion by one of the first shocks traveled four miles into the valley below.

The violence of the upward motion of the ground was singularly illustrated by the inversion of heavy bodies lying on the surface, and which can hardly be accounted for, except on the supposition that they were actually thrown to a considerable distance into the air. Thus, in some towns, a considerable proportion of the flat paving stones were found with their lower sides uppermost. Mr. Lyell accounts for this effect by supposing that the "stones were propelled upwards by the momentum which they had acquired, and that the adhesion of one end of the mass being greater than the other, a rotary motion had been communicated to them." But it is difficult to conceive how a whirling motion, so rapid as to produce such an effect, could have been communicated to a whole town, without producing some consequences still more extraordinary.

In the plain of Rosarno, a different effect

was produced from any yet described. This plain consists of an alluvial soil, which, after the commencement of the earthquakes, was found covered with circular hollows, containing water, and around the hollows were fissures radiating from their sides in every direction.

These were, for the most part, about the size of carriage wheels, but sometimes larger or smaller. When filled with water to within a foot or two of the surface, they appeared like wells, but more commonly they were filled with dry sand, sometimes with a concave, and at others with a convex surface. On digging into the earth, these cavities were found to be funnel-shaped, the moist, loose earth in the centre indicating the tube through which the water had ascended. When the water had disappeared, nothing was left in it but dry, micaceous sand. This sand appeared to have been brought up from beneath by the water which was sometimes found over the sand.

The Prince Scilla had persuaded many of his people to betake themselves to their fishing boats, as a place of safety, on the first in-

dications of an earthquake, which in that volcanic country are so well understood, and which create so much alarm. The Prince himself had set the example, by going on board one of these boats. On the 5th of February, when the first violent shock happened, many of these people were sleeping in their boats near the shore, while others were on the shore, at a place little elevated above the sea. With this convulsion the earth rocked, and suddenly there was precipitated a great mass of rock from Mount Jaci, on the plain where the people had taken refuge, and immediately after the water rose to a great height above its ordinary level, and swept away the sleeping multitude. The wave then instantly retreated, but soon after returned again with increased violence, bringing back many of the people, and animals, which it had carried away. At the same time every boat in the vicinity was overwhelmed, or dashed against the beach, and thus destroyed. The prince, who was an aged man, with 1,400 of his people, were thus swept away, and perished in the sea.

The number of human beings who were destroyed by this series of earthquakes, was esti-

mated by Sir William Hamilton at about 40,000, besides which nearly 20,000 more died by epidemics, which were occasioned by insufficient nourishment and the noxious vapors arising from the new lakes and pools of water, which this terrible catastrophe occasioned,—thus making the whole number that perished 60,000.

In countries where volcanoes exist, and which are also subject to earthquakes, experience has taught that the earthquakes cease, or become harmless, so soon as an eruption from the mountain commences.

EARTHQUAKE OF LISBON, IN PORTUGAL.

This great earthquake happened in the month of November, 1755, and with respect to the wide extent to which it was felt, exceeded all others of which there is any account. The first intimation of its approach was a loud subterranean noise, somewhat like distant thunder, and immediately afterwards the city of Lisbon was shook with such violence as to prostrate nearly all its houses. The wretched inhabitants, with so short a warning, were unable to take the least precaution for their

safety, so that in about six minutes 60,000 people perished.

The sea at first retired, and laid bare the bed of the harbor, after which it immediately rolled back in an immense wave, rising fifty feet at least above its ordinary level. The largest mountains in Portugal were shaken to their foundations, and several had their summits rent in a manner which struck every beholder with astonishment.

But the most extraordinary and calamitous effect which was produced at Lisbon, was the sinking of a quay, together with the thousands of inhabitants with which it was covered. This work was built entirely of marble, and just finished at an immense expense; and on it, after the first shock, a vast concourse of people had collected as a place of safety, having left the city to escape the fall of the houses. But it proved the most fatal spot in the vicinity, for at the next shock the earth opened and instantly swallowed up the whole quay, with the multitude which had there assembled, and so completely were the whole retained by the closing of the earth, that not a single dead body ever rose again to the sur-

face. A great number of small boats and other vessels near the quay, filled with people as a place of safety, were also precipitated into the yawning vortex, and it is stated that not a single fragment of any of these boats were ever seen afterwards. It was believed that the water where the quay stood was unfathomable, but its depth was afterwards found to be 600 feet.

The immense area over which this earthquake was felt, is very remarkable; for not only was every part of Spain and Portugal convulsed, but the shocks were perceived with greater or less intensity in England, Holland, Italy, Norway, Sweden, Germany, Switzerland, Corsica, the West Indies, at Morocco and Algiers in Africa, and in a part of South America. At Algiers the shock was so violent as to throw down many buildings; and a village not far from Morocco was swallowed up, and 10,000 inhabitants perished. A great wave from the sea swept nearly the whole coast of Spain. At Cadiz its height is said to have been sixty feet, and its devastations in proportion.

The shock was also felt by ships far at sea,

and, in several instances, the concussion was such as to make the people suppose their vessels had struck on a rock. In one instance it is said the people on board a vessel off the West Indies were thrown up a foot and a half from the deck. This circumstance may be accounted for from the inelasticity of water, so that a violent and sudden movement of the bottom of the ocean would be communicated to the surface and to the ship, through the medium of the fluid, with nearly the same force as though the vessel had been on the ground itself.

ISLANDS RAISED FROM THE SEA.

Numerous instances are recorded of the elevation of islands, of greater or less extent, from the bottom of the sea. Writers of antiquity have mentioned several such instances. The elder Pliny says that the celebrated islands of Rhodes and Delos, according to tradition, are sea-born, and that, after these, several smaller islands rose up from the bottom of the same sea. Strabo also asserts, positively, that Hiero was produced in the midst of flames, and both Plutarch and Justin relate that the

formation of this island was attended with much fire and a great boiling of the sea. But we are not entirely dependent on the ancients for facts of this kind, many instances of the elevation of islands having been witnessed in later times. Captain Tillard, of the Royal British Navy, was an eye witness to the rising of an island from the ocean in 1812. At some distance off the coast of St. Michael's one of the Azores, an immense body of smoke was observed to issue from the water, and from the midst of the smoke there suddenly burst forth a black column of cinders, ashes and stones, in the form of a spire. This was accompanied by vivid flashes of lightning from the thickest part of the volcanic smoke, and the whole was surrounded by occasional waterspouts.

The water at this place was thirty fathoms deep, and after the volcanic phenomena had lasted four days, the crater began to appear above the surface of the water, and soon became twenty feet high in the midst of an island 400 feet in diameter. At this time the cliffs of St. Michael's were shattered by an earthquake, and the island continued to rise

until it became at least 200 feet above the level of the sea.

This island was named Sabrina, after Capt. Tillard's ship. It did not, however, long continue visible, for being formed chiefly of ashes and cinders, and not by the elevation of the solid rocks, it was soon swept away by the waves of the ocean.

ALEUTIAN ISLANDS.

In the year 1806 there arose from the sea a new island, among the Aleutian group, north of Kamtschatka. This, according to Langsdorf, who afterwards visited the spot, was four geographical miles in circumference; and the geologist, Von Bush, infers from its not having subsided, that it does not, like Sabrina, consist of ejected volcanic matter, but of solid rock, thrown up from the bottom of the sea.

In 1814 another island was added to the Aleutian group from the bottom of the sea. This was much larger than the former, and its highest part was elevated to the astonishing height of 3,000 feet above the level of the sea.

In 1820 a new island was thrown up among the Ionian group, on the coast of Greece.

In 1757 eighteen small islands were elevated from the sea, in the vicinity of the Azores.

In 1783 the same phenomena happened on the coast of Iceland.

Many other instances of sea-born islands are recorded, but we need not extend this list, our chief object being to show that islands are elevated from the ocean by the force of volcanic action.

ELEVATION OF LAND BY VOLCANIC POWER.

In November, 1822, there happened a series of subterranean convulsions on the coast of Chili, which continued three months, and which shook that part of South America to the extent of 1,400 miles from north to south. On the morning after the first shock the whole line of coast along Valparaiso, to the distance of 100 miles, was found to have been raised above its former level. Mrs. Graham, who was present, and who writes this account, states that on the morning of the 20th the wreck of an old ship which lay at a small distance from the shore, but which could not be approached on account of the depth of the water, was now easily accessible. She also

found the former bed of the sea, along the shore, laid bare, with muscles, oysters and other shell fish adhering to the rocks on which they grew, and abundance of fish, dead and on dry land. At Valparaiso, the elevation of the land was found to be three feet, but at other places the rise was from four to five feet.

FORMATION OF MONTE NUOVO.

Monte Nuovo, or New Mountain, was chiefly thrown up on the night of the 29th of September, 1538. Its situation is in the neighborhood of Naples, a region everywhere volcanic.

The site of the present Monte Nuovo was formerly a little town, where invalids resorted on account of the thermal baths which existed there. On the evening above mentioned, after many previous shocks of an earthquake, the ground opened in the form of a wide fissure, which ran towards the town with a tremendous noise, accompanied with the discharge of pumice stones, blocks of lava and ashes. At the same time a gulf of considerable extent opened in the suburbs of the town, by which many houses were swallowed up. The sea

also retired, leaving its bed naked along the shore.

The fissure which had reached the town continued to discharge volcanic matter for 36 hours, during which time its quantity was such as to form the mountain in question. Its height has been lately determined to be four hundred and forty feet above the level of the bay of Naples. Its base is eight thousand feet, or nearly a mile and a half in circumference, and the depth of the crater four hundred and twenty-one feet from the summit, so that the bottom of the crater is only nineteen feet above the level of the sea.

No lava flowed from this crater, but the matter ejected, which fell down and formed the mountain, consisted of masses of ancient lava, ashes, pumice and slaty stones. These blocks of ancient lava prove the volcanic origin of the ground below the present mountain.

Thus, the earth almost everywhere indicates, by the position of its strata, that its crust has been disturbed by subterranean forces; and marine remains show that a great proportion of the dry land has once been under the sea. That these changes have been

effected by the same cause which elevates islands from the sea.

EARTHQUAKE OF CARACCUS, IN SOUTH AMERICA.

In the narrative of Professor Humboldt's journey to the Equinoctial regions of the new Continent, he has recorded all that he could collect with certainty respecting the earthquake of the 26th of March, 1812, which destroyed the City of Caraccus, together with 20,000 inhabitants of the province of Venezuela. From the beginning of 1811 till 1813 a vast extent of the earth's surface, limited by the meridian of the Azores, the valley of the Ohio, the cordilleras of New Grenada, the coasts of Venezuela and the volcanoes of the West Indies were shaken by subterranean commotions, indicative of a common agency exerted at a great depth in the interior of the globe. At the period when these earthquakes commenced in the valley of the Mississippi, the City of Caraccus felt the first shock in December, 1811, and on the 26th of March, 1812, it was totally destroyed. The inhabitants of terra firma were ignorant of the agitation which on the one hand the volcano of the

island of St. Vincent had experienced, and on the other the basin of the Mississippi, where, on the 7th and 8th of February, 1812, the ground was, day and night, in a state of continual oscillation. At this period the province of Venezuela labored under great drought; not a drop of rain had fallen at Caraccus, or to the distance of three hundred and eleven miles around, during the five months which preceded the destruction of the capital.

The 26th of March was excessively hot, the air calm and the sky cloudless. It was Holy Thursday, and a great part of the population was in the churches. The calamities of the day were preceded by no indications of danger. At seven minutes after four in the evening the first commotion was felt. It was so strong as to make the bells of the churches ring. It lasted about six seconds, and was immediately followed by another shock of from 10 to 12 seconds, during which the ground was in a continual state of undulation, and heaved like a fluid under ebullition. The damage was thought to be over, when a prodigious subterranean noise was heard, resembling the rolling of thunder, but louder and more pro-

longed than that heard in the tropics during thunder storms. This noise preceded a perpendicular motion of the ground, of about three or four seconds, followed by an undulatory motion of somewhat longer duration. The shocks were in opposite directions, from north to south and from east to west. It was impossible that anything could resist the motion from beneath upwards, and the undulations crossing each other. Thousands of the inhabitants (from nine to ten thousand) were buried under the ruins of the churches and houses. The procession had not yet set out, but the crowd in the churches was so great that nearly three or four thousand individuals were crushed to death by the falling in of the vaulted roof. The explosion was stronger on the north side of the town, in the part nearest the mountains of Avila and the Silla. The churches of the Trinity and the Alta Gracia, which were more than a hundred and fifty feet in height, and of which the nave was supported by pillars from twelve to fifteen feet in diameter, left a mass of ruins nowhere higher than five or six feet. The sinking of the ruins has been so great that at

present hardly any vestige remains of the pillars and columns. The barracks called El Guartel de San Carlos, situated farther to the north of the Church of the Trinity, on the road to the Custom House de la Pastora, almost entirely disappeared. A regiment of troops which was assembled in it under arms to join in the procession, was, with the exception of a few individuals, buried under this large building. Nine-tenths of the fine town of Caraccus was entirely reduced to ruins. The houses which did not fall, as those of the street of San Juan, near the Capuchin Hospital, were so cracked that no one could venture to live in them. The effects of the earthquake were not quite so disastrous in the southern and western parts of the town between the great square and the ravine of Caraguata; there the cathedral, supported by enormous buttresses, remains standing.

In estimating the number of persons killed in the City of Caraccus at nine or ten thousand, we do not include those unhappy individuals who were severely wounded, and perished several months after from want of food and proper attention. The night of Holy

Thursday presented the most distressing scenes of desolation and sorrow. The thick cloud of dust, which rose above the ruins and darkened the air like a mist, had fallen again to the ground; the shocks had ceased; never was there a finer or quieter night,—the moon, nearly at the full, illuminated the rounded summits of the Silla, and the serenity of the heavens contrasted strongly with the state of the earth, which was strewn with ruins and dead bodies. Mothers were seen carrying in their arms children whom they hoped to recall to life; desolate females ran through the city in quest of a brother, a husband, or a friend, of whose fate they were ignorant, and whom they supposed to have been separated from them in the crowd. The people pressed along the streets, which now could only be distinguished by heaps of ruins arranged in lines.

All the calamities experienced in the great earthquakes of Lisbon, Messina, Lima and Reobamba were repeated on the fatal day of the 26th of March, 1812. The wounded, buried under the ruins, implored the assistance of passers-by with loud cries, and more than two thousand of them were dug out. Never

was pity displayed in a more affecting manner; never, we may say, was it seen more ingeniously active than in the efforts made to succor the unhappy persons whose groans reached the ear. There was an entire want of instruments adapted for digging up the ground and cleaning away the ruins, and the people were obliged to use their hands for the purpose of disinterring the living. Those who were wounded, as well as the patients who had escaped from the hospitals, were placed on the bank of the little river of Guayra, where they had no other shelter than the foliage of trees.

Beds, linen for dressing their wounds, surgical instruments, medicines; in short, every thing necessary for their treatment, had been buried in the ruins. During the first days nothing could be procured—not even food. Within the city, water became equally scarce. The commotion had broken the pipes of the fountains, and the falling in of the earth had obstructed the springs which supplied them. To obtain water it was necessary to descend as far as the Rio Guayra, which was considerably swelled, and there were no vessels for drawing it.

There remained to be performed towards the dead a duty imposed alike by piety and the dread of infection. As it was impossible to inter so many thousands of bodies, half buried in the ruins, commissioners were appointed to burn them. Funeral-piles were erected among the rubbish. This ceremony lasted several days; and with so many public calamities, the people ardently engaged in the religious exercises which they thought best adapted to appease the anger of Heaven. Some walked in bodies, chanting funeral-hymns; while others, in a state of distraction, confessed themselves aloud in the streets. In this city was now repeated what had taken place in the province of Guito after the dreadful earthquake of the 4th of February, 1797. Marriages were contracted between persons who for many years had neglected to sanction their union by the sacerdotal blessing. Children found parents in persons who had till then disowned them; restitution was promised by individuals who had never been accused of theft; and families who had long been at enmity drew together, from the feeling of a common evil. But while in some this feeling

seemed to soften the heart and open it to compassion, it had a contrary effect on others, rendering them more obdurate and inhuman. In great calamities vulgar minds retain still less goodness than strength; for misfortune acts like the pursuit of literature and the investigation of nature, which exercise their happy influence only upon a few, giving more warmth to the feelings, more elevation to the mind, and more benevolence to the character.

Shocks so violent as these, which in the space of one minute overthrew the City of Caraccus, could not be confined to a small portion of the continent. Their fatal effects extended to the provinces of Venezuela, Varinas and Maracaybo, along the coast, and were more especially felt in the mountains of the interior. La Guayra, Mayguetia, Antimana, Baruta, La Vega, San Felipe and Merida were almost entirely destroyed.

The number of dead exceeded five thousand at Guayra and at the Villa de San Felipe, near the copper mines of Aroa. The earthquake would appear to have been most violent along a line running from E. N. E. to W. S. W., from Guayra and Crraccus towards the high mountains of Niquitas and Merida.

It was felt in the kingdom of New Grenada, from the ramifications of the lofty Sierra of Santa Martha to Santa Fe de Begota, and Honda, on the banks of the Magdalena, 620 miles distant from Caraccus. In all parts it was more violent in the cordilleries of gneiss and mica-slate, or immediately at their base, than in the plains. This difference was particularly remarkable in the savannas of Varinas and Casanare. In the vallies of Aragua, situated between Caraccus and the town of San Filipe, the shock was very weak. La Victoria, Maracay and Valencia scarcely suffered, notwithstanding the proximity of the capital. At Valicillo, not many leagues distant from Valencia, the ground opened and emitted so great a mass of water that a new torrent was formed. The same phenomena took place near Porto Cabello. On the other hand, the Lake of Maracaybo underwent considerable diminution. At Corono commotion was felt, although the town was situated on the coast between other towns which suffered. The fishermen who had passed the day of the 26th March in the Island of Orcila, 130 miles north-east of L. Guayra, were not sensible of any shock.

Towards the east of Caraccus the commotions were very violent, especially beyond Caurimare, in the valley of Capaya, and as far as the meridian of Cape Cordera, while they were very feeble on the coasts of New Barcelona, Cumana and Paria, though these shores are known to have been formerly shaken by volcanic vapors. Fifteen or eighteen hours after the great catastrophe the ground ceased to be agitated; but subsequently to the 27th the tremblings recommenced, and were accompanied with very loud subterranean noises.

Frequently not less than fifteen oscillations were felt in one day. On the 5th of April there was an earthquake almost as severe as that of the 12th of March. The surface was in continuous undulation during several hours, large masses of earth fell in the mountains, and enormous rocks were detached from the Silla.

While violent agitations were experienced in the valley of the Mississippi, in the Island of St. Vincent, and in the province of Venezuela, a subterranean noise, resembling an explosion of artillery, was heard at Caraccus, at Calabazo, and on the banks of the Rio Aquere,

over the space of four thousand square leagues. This sound began at two in the morning of the 30th of April, and was as loud on the coast as at the distance of eighty leagues. It was everywhere taken for the firing of guns. On the same day a great eruption of the volcano of the Island of St. Vincent took place. This mountain had not ejected lava since 1718, and hardly any smoke was issuing from it when, in May, 1811, frequent shocks occurred, and a discharge of ashes, attended with a tremendous billowing, followed on the 27th of April next year. On the 30th lava flowed, and after a course of four hours it reached the sea. The explosions resembled alternate volleys of very large cannon and musketry. As the space between the volcano of St. Vincent and the Rio Apure is 725 miles, these were heard at a distance equal to that between Vesuvius and Paris, and must have been propagated by the earth, and not by the air.

After adducing numerous instances of the coincidence of volcanic eruptions and earthquakes, Humboldt endeavors to prove that subterranean communications extend to vast distances, that the phenomena of volcanoes

and earthquakes are intimately connected, and that the latter have certain lines of direction.

FISH THROWN FROM VOLCANOES.

The fact is well known that fishes, sometimes alive, are frequently thrown out of certain volcanoes when in eruption. The phenomenon has been observed at Mount Cotopaxi, in South America, and at other volcanoes in the same region. The fishes are all of one kind at this volcano, and instances are on record of the numbers of them ejected being so large that the odor while they were decaying poisoned the whole region over which they fell.

The species of fish thrown forth from this volcano is found to exist in several lakes on the sides of these mountains, about 10,000 feet above the sea; but even supposing that these lakes communicate with other bodies of water in the interior of the earth, it seems strange that fish, capable of existing in a cold climate, can live in the temperature which must prevail in these subterranean reservoirs, directly in the line of fire of a volcano.

Other volcanoes are known to have thrown out fish belonging to the ocean.

TEMPLE OF JUPITER SERAPIS.

In a few instances, it is known that portions of land have several times changed their level, with respect to that of the sea; and of which the following is an interesting and curious example:

The temple of Serapis, a celebrated monument of antiquity, is situated on the little bay, called Baiæ, within the bay of Naples.

A geological examination of the coast of Puzzuoli, along this bay, shows that the land has been elevated about twenty feet, at a period not very remote, so that, without the evidence presented by the temple, there is sufficient proof that the land in the vicinity has changed its level.

If the coast along the shore between Naples and Puzzuoli be examined, it will be seen that the tract of fertile land which intervenes between the present shore and the high, rocky cliffs was evidently once under water, and that the ancient shore was near these cliffs.

The inland cliff near Puzzuoli is in many places about eighty feet high and quite perpendicular. At its base the new deposit attains the height of twenty feet above the sea. This consists of sedimentary matter, mixed with marine shells, showing that it was formed under the water.

The soil of these level deposits is considered so valuable that a wall has been built for its protection against the washing of the sea; but in some places the wall has been thrown down, so that the strata are exposed. These consist of alternate layers of mud and pumice, enclosing abundance of marine shells. One stratum contains large quantities of the remains of ancient art, as tiles and pieces of Mosaic pavement.*

The remains of the works of art are found below, as well as above the marine shells. Among the shells are the Cardium, Donax, Buccinum and Ostrea.

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*Ancient Mosaic pavement consists of small pieces of stone, generally marble, of different colors, arranged in figures, sometimes representing groups of men and animals, in commemoration of some historical event. These are cemented so as to form a continuous solid mass. The floors of ancient churches and temples were often thus made.

Now, there are no tides in the Mediterranean by which these shells could have been cast upon the shore; and the remains of ancient buildings at other places show that there has been no change in the level of this sea for the last two thousand years; hence, we must conclude that the land along this coast has been elevated about twenty feet above its former level.

But in addition to the above evidence, the remains of the temple of Serapis show that the edifice has undergone several changes of level, when compared with the sea.

With respect to this temple, Mr. Lyell, who has visited the spot, says: "It appears, from the most authenticated accounts, that the three pillars, now standing erect, continued down to the middle of the last century, half buried in the new marine strata above described. The upper parts of the columns being concealed by bushes, had not been discovered until 1750, when they were seen to form part of a splendid edifice. On examination, the pavement was found still entire, and upon it lay a number of magnificent columns, a part of which were of granite, and a part of African

breccia.* The original plan of the building could be traced distinctly; it was of a quadrangular form, seventy feet in diameter, and the roof had been supported by forty-six noble columns, twenty-four of which were of granite, and the rest of brecciated marble. The large court had been surrounded by apartments, supposed to have been used as bathing rooms; for a thermal spring, still employed for medical purposes, continues to flow from just behind the ruins, and the water of this spring, it is said, was conveyed to the chambers by marble conductors."

These pillars are forty-two feet in height, and their surfaces are smooth and entire to the height of about twelve feet above the pedestal, the reason of which will appear directly. Above this is a zone, twelve feet in length, where the marble has been pierced by a marine perforating shell fish, called by Cuvier, Lithodomus. It is a species of the Mytilus of Linnæus and the Modiola of Lamarck.

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*Breccia is a rock composed of broken, angular pieces of stone, generally of various colors, cemented by the hand of nature. The pillars of the capitol at Washington are of this kind of marble.

These animals enter the stone by a small orifice, which they make themselves when quite young, and as they increase in size they enlarge their habitations in proportion. They are nourished by the sea water, which is admitted through the small aperture. These animals have not the power, or perhaps inclination, to leave their cells; hence their houses during life become their tombs at death.

The limestones on the shores of the Mediterranean are frequently full of the excavations of these animals. The genus Pholas also contains some species which penetrate rocks.

As these animals cannot live except when immersed in salt water, we must infer that these pillars were for a long time submerged, and that, during part of that period, their lower portions were covered up by the rubbish already mentioned, while their upper ends reached above the water. This accounts for the reason why their middle portions only are perforated by these animals. On the pavement of the temple lie several columns, broken in pieces. These are perforated on their fractured ends, as well as on other parts, showing

that they had lain under water for a long time after they were broken.

The platform of the temple is at present just under the water, and the upper part of the perforations on the standing columns is at least twenty-three feet above the water, from which it is clear that these columns must have continued for a long time immersed in the water while in an erect position, after which they must have been raised by the rising of the ground to their present elevation.

Thus it appears that the temple of Serapis was first depressed by the sinking down of the ground where it stands, so that the water of the sea surrounded these pillars about twenty feet above its present level; after which it was again raised to its present situation by the elevation of the coast. It is hardly necessary to say, that the cause of these changes was undoubtedly the same which has produced the elevation of islands and the sinking down of the ground in other places.

GULF STREAM.

Between the tropics, from the coast of Africa, especially from the coast of Senegal to the Caribbean Sea, there is a stream that always flows from east to west, and which is named the Equinoctial Current. Its mean rapidity may be estimated at ten or eleven miles in twenty-four hours. This movement of the waters, which is also observed in the Pacific Ocean, having a direction contrary to that of the earth's rotation, is supposed to be connected with the latter only in so far as it changes into trade-winds those aerial currents from the poles, which, in the lower regions of the atmosphere, carry the cold air of the high latitudes towards the equator; and it is to the general impulse which these winds give to the surface of the ocean that the phenomenon in question is to be attributed. This current carries the waters of the Atlantic towards the Mosquito and Honduras coasts in South America; from thence they move northwards,

and passing through the Caribbean Sea into the Gulf of Mexico, follow the bendings of the shore to Vera Cruz; thence to the mouth of the Rio del Norte; and from thence to the mouths of the Mississippi and the shoals at the southern extremity of Florida. Here, being headed by the Bahama Islands, it turns its course northward, rushing with great impetuosity through the Straits of Bahama. At the end of these narrows, in the parallel of Cape Canaveral, the flow which rushes onward like a torrent, sometimes at the rate of five miles an hour, runs to the north-east. Its velocity diminishes and its breadth enlarges as it proceeds northward.

Between Cape Biscayo and the banks of Bahama the width is only 52 miles, while in 28½ degrees of latitude it is 59 miles; and in the parallel of Charleston, opposite Cape Henlopen, it is from 138 to 173 miles, the rapidity being from three to five miles an hour where the stream is narrow. To the east of Boston and in the meridian of Halifax the current is nearly 276 miles broad. Hitting on the head lands of Newfoundland, it suddenly turns towards the east; from Newfoundland to the

Azores it continues to flow to the east and E. S. E., still retaining part of the impulse which it had received nearly 1,150 miles distant in the Straits of Florida. In the meridian of the Isles of Coroo and Flores, the most western of the Azores, it is not less than 552 miles in breadth. From the Azores it directs itself towards the Straits of Gibraltar, the Island of Madeira and the Canary Isles. To the south of Madeira we can distinctly follow its motion to the S. E. and S. S. E., bearing on the shores of Africa, between Capes Contin and Bijador. Cape Blanco, which, next to Cape Verd, farther to the south, is the most prominent part of that coast, seems again to influence the direction of the stream; and in this parallel it mixes with the great equinoctial current, as already described.

In this manner the waters of the Atlantic, between the parallels of 11 and 43 degrees, are carried around in a continual whirlpool, which Humboldt calculates must take two years and ten months to perform its circuit of 13,118 miles. This great current is named the Gulf Stream. Off the coast of Newfoundland a branch separates from it, and runs from south west to north-east, towards the coast of Europe.

NOAH'S ARK.

Noah was one hundred years in building the Ark. The size of the Ark was as follows: 547 feet long, 91 feet wide, 54 feet deep, and could carry 21,762 tons burthen.

The belief of the people in Armenia respecting the Ark is as follows: These people, who have long been followers of the Christian faith, regard Mount Ararat with the most intense veneration, and have many religious establishments in its vicinity. They firmly believe, to a man, that the Ark is still preserved on the summit of the mountain, and that in order to preserve it the ascent of Mount Ararat has been prohibited to mortals, by a divine decree, since the time of Noah. The origin of this traditionary belief, which is sanctioned by the church, and has almost become an article of Armenian faith, is said to be as follows: A Monk in former times, who was anxious to settle some doubts relative to the scriptural account of Noah, resolved, for

this purpose, to ascend to the top of Mount Ararat, to satisfy himself whether or not the Ark was there. On the declivity of the mountain, however, he had several times fallen asleep from exhaustion, and on waking he found himself always carried back to the very place from which he had first started. At length, out of pity, an angel was sent to him with the information that he had entered on an impracticable task; but at the same time his zeal was rewarded by a divine present of a piece of the Ark.

This piece is to this day preserved as the most valuable relic in the neighboring convent of Etschmiadisan, the seat of the Patriarch, or Primate of the Church of Armenia.

RECENT DISCOVERIES AT POMPEI.

The following recent discoveries were received too late to be inserted in the body of the book:

Interesting researches have recently been made in the ruins of the buried City of Pompei. In the porch of a small house two skeletons were found, one of them being incontestibly that of a woman, as it had on a bracelet in mosaic gold, of an unusual form, composed of thick rings soldered to each other, the whole being fastened by two pieces of wire of the same metal. The day after, in the garden of the same building, was discovered a small statue, seated, about two feet high, of a rather uncommon model. It is in terra cotta, but of no definite type. The head, in fact, is absolutely that of a Jupiter; the figure is covered with a tunic, having short sleeves, which only covered the upper part of the arms; the legs and hands are crossed; a cloak falls from the shoulders and envelops the lower limbs; the

right hand holds a papyrus, so that the belief is, it must represent a philosopher. Two days after, however, a more important work of art was found at the bottom of another garden contiguous to the one above mentioned, namely, a marble Venus, measuring, including the base, more than a yard in height. It is in perfect preservation, as it only wants two fingers of the right hand; but the most remarkable characteristic is that it is colored.

The excavations of Pompei and Herculaneum have produced many other specimens of painted marble, but the tints have all more or less faded away. In the present work the hair is yellow, the eyelashes and eyebrows black. The tunic, which from the left arm passes behind the shoulders, descends on the legs and covers the lower parts, is also tinted yellow outside, while the interior folds show show at the edges some traces of blue and red. The nude parts are white. The left arm, the hand of which holds the apple of Paris, rests upon a smaller statue, the drapery of which is also tinted yellow, green and black.

MISCELLANEOUS.

THE GREAT EASTERN.

This ship is 692 feet long, 120 feet wide, 58 feet and six inches deep, and its tonnage is 22,500 tons. Its paddle wheels are 50 feet in diameter, has 40 furnaces to heat boilers, and consumes over eleven tons of coal per hour. Total power of engines, 11,500 horse. The ship will accommodate 4,000 passengers, or 20,000 troops. It took six years to build it. Estimated cost, $8,400,550.

WELLS.

In digging a well at Cincinnati, Ohio, when they arrived 70 feet below the surface of the ground they came upon a standing stump, with an axe lying upon it, very much eaten by rust, so much so that it was easily broken to pieces. This shows that the surface of the ground was once 70 feet below the present surface.

On digging a well in Illinois, when 18 feet down they came to some flat stone, and on re-

moving them they came to a regular stoned up well. They ran a pole down and found it to be 18 feet deep, with water at the bottom. They drew up some of the water, and found it to be good spring water; they then continued the wall of the well up to the present surface of the ground, and had a good well of water. This also shows that the surface of the ground had been changed. And how many times this earth has been modled and remodled over is not for man to know.

RAMIE.

Ramie is the name of a new fibrous plant that is attracting attention in the South. It is of the nature of flax, only it works up into a much finer fibre, and, when manufactured into fabric, makes an article equal to some of the coarser imported silks. It will yield from three to five crops a year, and is proof against overflow and the army worm, those two great pests of cotton culture.

It is likely to be an important produce in the South. It is already in great demand from English manufacturers, and promises to become one of our principal exports. Its supe-

riority to cotton, both in its abundance and certainty of yield, and in the quality of the cloth made from it, will probably make the raising of ramie the next agricultural epidemic.

We hope that ramie may offer inducements to some of our Southern brethren, if not to quit raising cotton, at least to quit "raising Cain."

A Ramie Planting and Manufacturing Company has been organized in New Orleans for the purpose of manufacturing fabrics to be woven from the fibre of the ramie plants. The company have elected officers, purchased a plantation and commenced business.